THE

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Science,

HALIFAX, NOVA SCOTIA.

VOLUME XIII

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SESSION OF 1912-1913

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THE attention of members of the Institute is directed to the following recommendations of the British Association Committee on Zoological Bibliography and Publications:—

"That authors' separate copies should not be distributed privately before the paper has been published in the regular manner.

"That it is desirable to express the subject of one's paper in its title, while keeping the title as concise as possible.

"That new species should be properly diagnosed and figured when possible.

"That new names should not be proposed in irrelevant footnotes, or anonymous paragraphs.

"That references to previous publications should be made fully and correctly, if possible in accordance with one of the recognized sets of rules of quotations, such as that recently adopted by the French Zoological Society."

PROCEEDINGS

OF THE

Nova Scotian Institute of Science.

SESSION OF 1912-13.

Annual Business Meeting.

Civil Engineering Lecture Room, Technical College,
Halifax, 11th November, 1912.

The President, Watson L. Bishop, in the chair.

Active members present: Dr. A. H. MacKay, Donald M. Fergusson, M. Bowman, Prof. E. Mackay, A. L. McCallum, Prof. C. L. Moore, D. S. McIntosh, Prof. A. S. MacKenzie, Prof. H. L. Bronson, Prof. D. Fraser Harris, C. B. Nickerson, R. H. Brown, W. McKerron, A. J. Barnes and H. Piers.

In the absence of a presidential address, the Corresponding Secretary (Prof. E. Mackay) presented a report on the work of the Institute during the past year, and suggesting lines of work that might be taken up in the future.

The Treasurer, M. Bowman, presented his annual report, showing that the receipts for the year ending 31st October, 1912, were $809.91, the expenditures $241.48, and the balance in current account was $568.43; while the reserve fund was $708.51, and the permanent endowment fund, $912.13. The report, having been audited, was received and adopted.

The Librarian's report was presented by H. Piers, showing that 1,688 books and pamphlets had been received by

the Institute through its exchange list during the year 1911; and 1,298 have been received during the first ten months of the present year, 1912, viz. January to October inclusive. The total number of books and pamphlets received by the Provincial Science Library (with which those of the Institute are incorporated) during the year 1911, was 3,088. The total number in the Science Library on 31st December, 1911, was 45,497. Of these, 34,085 (about 75 per cent.) belong to the Institute, and 11,412 to the Science Library proper. Six hundred and forty-two books were borrowed, besides those consulted in the library. It was again reported that no binding or purchasing was done during the year, there being no grant for the library's support. The report was received and adopted.

Dr. A. S. MacKenzie and others spoke of the great need of having the volumes bound in the library, and it was agreed that some action should be taken in the matter.

The following question was then discussed: Whether the Institute shall offer money grants, when needed, to scientific research students, to assist in furnishing necessary apparatus, etc.; it having been suggested that two grants might be offered of $50.00 each and four of $25.00 each.

The subject was discussed by Dr. Fraser Harris, Dr. MacKenzie, Dr. A. H. MacKay, Dr. E. Mackay, and Mr. Piers.

On motion of Dr. E. Mackay and Prof. Bronson, it was resolved that the Council of the Institute be empowered to expend, at its discretion, a sum not to exceed fifty dollars to aid scientific research.

The consideration of the celebration of the Fiftieth Anniversary of the Foundation of the Institute, was referred back to the Council.

It was announced that Albert Johnstone Barnes, service inspector, Maritime Telegraph and Telephone Co.,

Halifax, had been duly elected an ordinary member on 4th October last.

Frank William Dodd, Assoc. Mem. I. C. E., of Brooklyn, N. Y., and Weymouth, England, gave an address on "Integral Atomic Weights," in which he advanced a new theory on the subject. (See Transactions, page 216.) The subject was discussed by Prof. E. Mackay, Prof. Bronson, Dr. A. H. MacKay, and Prof. A. S. Mackenzie, and a vote of thanks was presented to the lecturer.

The following were elected officers for the ensuing year (1912-13):

President,—Donald MacEachern Fergusson, F. C. S., *ex officio* F. R. M. S.

1st Vice President,—Alexander Howard MacKay, Ll. D., F. R. S. C.

2nd Vice President,—Professor Howard Logan Bronson, Ph. D.

Treasurer,—Maynard Bowman, B. A.

Corresponding Secretary,—Professor Ebenezer Mackay, Ph. D.

Recording Secretary and Librarian,—Harry Piers.

Councillors without office,—Parker R. Colpitt; Professor Clarence L. Moore, M. A.; Alexander McKay, M. A.; Professor David Fraser Harris, M. D., C. M., D. Sc., B. Sc. (Lond.), F. R. S. E.; Donald Sutherland McIntosh, B. A., M. Sc.; Carleton Bell Nickerson, M. A.; and Watson Lenley Bishop.

Auditors—George B. Bancroft, B. A., and William McKerron.

On motion of Mr. Piers and Prof. Mackay a vote of thanks was presented to the retiring president, Mr. Bishop.

The Proceedings and Transactions, vol. xiii, part 2, were distributed.

First Ordinary Meeting.

Civil Engineering Lecture Room, N. S. Technical College, Halifax; 9th December, 1912.

The First Vice President, Dr. A. H. MacKay, in the chair.

It was announced that J. H. L. Johnstone, demonstrator of physics, Dalhousie University, Halifax, had been duly elected an ordinary member.

Harry Piers, curator of the Provincial Museum, Halifax, read a paper on "The Occurrence of European Birds in Nova Scotia," and exhibited a specimen of the European Widgeon recently taken here. (See Transactions, page 228.)

Watson L. Bishop read a paper entitled "A Curious Lightning Freak." (See page 240.) The subject was discussed by the Chairman, Mr. Piers, Mr. Colpitt, Prof. Bronson, Mr. Barnes, and Prof. Fraser Harris, some of whom gave accounts of remarkable lightning effects as observed by themselves.

On motion of Prof. Mackay and Mr. Nickerson it was resolved that the Recording Secretary be requested to prepare for the Transactions a sketch of the history of the Institute during the past fifty years, with biographical notes on those who had assisted materially in its work.

Second Ordinary Meeting.

[Commemoration Meeting, 1862-1912.]

Civil Engineering Lecture Room, N. S. Technical College, Halifax; Monday, 20th January, 1913.

The Nova Scotian Institute of Science met at 8 p. m. to commemorate the completion of half a century's work of the society, which had been organized at Halifax on the 31st

of December, 1862, as the successor of the Nova Scotian Literary and Scientific Society and the older Halifax Mechanics' Institute (1831).

The chair was occupied by the PRESIDENT, DONALD M. FERGUSSON, F. C. S., *ex officio* F. R. M. S. Other members present were: A. H. MACKAY, LL. D., F. R. S. C., first vice-president; PROF. EBENEZER MACKAY, PH. D., corresponding secretary; HARRY PIERS, recording secretary; and PROF. D. FRASER HARRIS, M. D., C. M., D. Sc., F. R. S. E.; DONALD S. MCINTOSH, M. Sc.; CARLETON B. NICKERSON, M. A.; and WATSON L. BISHOP, members of council; WILLIAM MCKERRON, auditor; and W. C. STAPLETON and J. H. L. JOHNSTONE, ordinary members.

The President announced the special purpose for which the meeting had been called.

There was read a paper by PROF. DAVID FRASER HARRIS, M. D., C. M., D. Sc., F. R. S. E., of Dalhousie University, entitled "A Note on a Gastrolith found in a Moose." (See Transactions, page 242.) The subject was discussed by DR. A. H. MACKAY, H. PIERS, and others.

The RECORDING SECRETARY, HARRY PIERS, read a paper which he had prepared at the request of the society, entitled "A Brief Historical Account of the Nova Scotian Institute of Science, and the events leading up to its establishment; with Biographical Notes on some of those who have been prominent in its affairs." (See page liii.) Owing to lack of time, the presention of the biographical section of the paper was deferred to the next meeting. Remarks on the subject of the paper were made by the PRESIDENT, DR. A. H. MACKAY, DR. E. MACKAY, and others; and on motion of DRS. A. H. and E. MACKAY a vote of thanks was presented to MR. PIERS.

Attention was drawn to the fact that GENERAL CAMPBELL HARDY was the sole-surviving original member of the society,

and on motion of H. PIERS and DR. A. H. MACKAY, it was unanimously

"Resolved that the Nova Scotian Institute of Science, on the occasion of its meeting to commemorate the completion of half a century's work in the field of science in Nova Scotia, extends its hearty congratulations to its sole-surviving original member and former vice-president, MAJOR-GENERAL CAMPBELL HARDY, R. A., of Dover, England, the talented author of 'Forest Life in Acadie,' and that it furthermore expresses its high appreciation of his work for it in the past, and of his continued interest in all of its affairs; and that a copy of this resolution be forwarded to General Hardy."

THIRD ORDINARY MEETING.

Civil Engineering Lecture Room, N. S. Technical College, Halifax; 10th Febrdury, 1913.

THE PRESIDENT, D. M. FERGUSSON, in the chair.

The following telegram from the HONORARY SECRETARY OF THE ROYAL SOCIETY OF CANADA, dated at Ottawa, 20th January, 1913, and received the day after the commemoration meeting, was read by the Recording Secretary:

"Harry Piers, Nova Scotian Institute of Science, Halifax. The Royal Society of Canada congratulates the Nova Scotian Institute of Science upon the completion of a half century of endeavour. Most hearty wishes for continued usefulness and success.—DUNCAN SCOTT."

THE RECORDING SECRETARY stated that he had forwarded a due acknowledgment of the message to Mr. Scott.

An interesting letter from GENERAL CAMPBELL HARDY, our sole-surviving original member, dated at Dover, 20th January, was read, thanking the Institute for the cablegram sent to him on the occasion of the commemoration meeting, and giving reminiscences of the establishment of the society, etc.

The RECORDING SECRETARY, HARRY PIERS, presented a series of "Biographical Sketches of the Deceased Presidents and other Prominent Members of the N. S. Institute of Science since 1862," being the concluding section of an historical account of the society, the first portion of which had been read at the last meeting. (See page lxxxii.)

Discussion took place as to the ways in which more interest in natural history and science in general might be aroused among the people of the province.

FOURTH ORDINARY MEETING.

Assembly Room, N. S. Technical College, Halifax; 4th April, 1913.

THE PRESIDENT, D. M. FERGUSSON, in the chair.

DAVID FRASER HARRIS, M. D., C. M., D. Sc., B. Sc. (Lond.), F. R. S. E., professor of physiology, Dalhousie University, Halifax, read a paper entitled, "Ventilation: its Discovery and Discoverer, and its bearing upon Tuberculosis," with lantern illustrations. The lecture dealt with the life and work of the Rev. Stephen Hales, D. D., F. R. S., 1677-1761, the inventor of ventilators (first described in 1743) which have had a most remarkable effect in lessening diseases. On motion of H. N. PAINT and M. THEAKSTON, a vote of thanks was presented to Dr. Harris for his lecture.

FIFTH ORDINARY MEETING.

Civil Engineering Lecture Room, N. S. Technical College, Halifax, 12th May, 1913.

THE PRESIDENT, D. M. FERGUSSON, in the chair.

DR. A. H. MACKAY was appointed delegate to represent the Institute at the forthcoming meeting of the Royal Society of Canada.

The appointment of a representative to attend the fiftieth annual meeting of the Entomological Society of Ontario, to be held at Guelph, Ontario, on 27th to 29th August next, was left to the President and the Secretary.

Donald Sutherland McIntosh, M. Sc., instructor in geology and mineralogy, Dalhousie University, Halifax, read a paper entitled, "Notes on a Granite Contact Zone near Halifax, N. S." (See Transactions, page 244.) The subject was discussed by W. H. Prest, H. Piers, and others.

A paper by Frank Henry Reid, M. D., C. M., SS. "Crispin," China Mutual Navigation Co., Liverpool, England, entitled "The Irregularity in the Occurrence of Secondary Sexual Colours, and deductions therefrom," was read by title, owing to the lateness of the hour; as was also one by A. H. MacKay, LL. D., F. R. S. C., on "Phenological Observations in Nova Scotia, 1912." (See Transactions, page 250.)

Harry Piers,
Recording Secretary.

A Brief Historical Account of the Nova Scotian Institute of Science, and the events leading up to its formation; with Biographical Sketches of its Deceased Presidents and other Prominent Members.—By Harry Piers, Curator of the Provincial Museum, Halifax.

(Read at Commemoration Meeting, 20th January, 1913.)

Pioneer Naturalists.

No backward glance at the progress of scientific affairs in Nova Scotia would be at all complete without some reference to the pioneer workers in the field, the men who collected and observed, and thought and wrote, or otherwise laboured without the inspiring presence in their midst of institutions of learning and research, and companions of similar tastes.

The names we meet in this period are not many; but, *ipso facto*, something akin to a halo must surround them because these men were the Fathers of Science in this province.

Passing by the early voyagers and settlers, whose occasional hap-hazard observations on natural history are mostly of mere historic interest, we find that the close study of that subject seems to have begun about 1800 with Titus Smith, a man who was remarkable in many ways. He was followed by MacCulloch, Gesner, Webster, Brown and others, of whom I will give a few particulars.

Titus Smith, botanist, etc., was born at Granby, Mass., 4th September, 1768, and died at the Dutch Village, near Halifax, 4th January, 1850. He came to Nova Scotia with his father, a Yale graduate, in 1785, and settled at Preston, near Dartmouth, removing to the Dutch Village about 1800. He was remarkably well read and most accurate in his knowledge of many subjects, and became well known to all of his day as "The Dutch Village Philosopher." He was a most

enthusiastic student of botany, collected and observed all over the province, and conveyed the information he gained to the prominent botanists of the time in England, Scotland, France and elsewhere. He was also interested in geology, and in fact in natural history in general, as well as in the most improved methods of agriculture. As a general naturalist he was in advance of any others of his time in Nova Scotia, and his ability to read readily in various languages, placed scientific literature within his easy reach. In local history he was an acknowledged authority. About 1801-2 he was employed by the government to make a general tour or survey of the unsettled regions of the province, on which he left a voluminous manuscript report, including an account of our trees. Land surveying he took up as a profession. Unfortunately he published almost nothing over his own name, being of an exceedingly modest and retiring disposition; but he gave most liberally of his information to others and often wrote anonymously for the local press. The descriptive text of the first issues of Miss Maria Morris's superb "Wild Flowers of Nova Scotia" (about 1840) was written by him, and he collected the plants which that talented artist portrayed. His evidence before the Durham Commission of 1843 shows his extensive knowledge of the province. He contributed articles to the local press on the subjects of agriculture, rural economy, education, chemistry, geology and botany, and occasionally lectured before the Mechanics' Institute. For many years he was secretary of the Central Board of Agriculture and for a time conducted an agricultural periodical. Murdoch says of him that he was remarkable for the vast and varied information he acquired in botany, natural history, etc., and that with a knowledge of most that nature and books can teach, he united an unfeigned simplicity and kindness to the lowest as well as to the highest in the land, recognizing no distinction of rank whatever. On one occasion this Institute made a pilgrimage to his grave in the

woods near the Three-mile House, which will be found described in our Transactions. (See Lawson, M. J. K., History of Dartmouth, pp. 205-218; Trans. N. S. I. N. S., vol. i, pt. 4, pp. 149-152).

Rev. Thomas MacCulloch, D. D., ornithologist, was born at Neilston, Scotland, in 1776, and died at Halifax, N. S., 10th September, 1843. He was educated at the University of Glasgow and at Whiteburn, came to Nova Scotia in November, 1803, and was appointed first minister of Prince St. Church, Pictou, 6th June, 1804. From 1817 to 1824 he was the first principal of Pictou Academy, and in 1838 was appointed principal of Dalhousie College, Halifax. He made a study of our natural history, being particularly interested in birds, but also gave attention to mineralogy and left a manuscript list of Nova Scotian mineral localities which has since been published by this Institute. Audubon has left an account of meeting him in August, 1833 (See Audubon's Journal). MacCulloch's collection of birds is now the property of Dalhousie University, and, although badly mounted, contains some rare specimens, such as that of the Labrador Duck. Regarding the MacCulloch collection, it may be noted that Audubon says, "I am much surprised that his valuable collection had not been purchased by the governor of the province, to whom he offered it for five hundred pounds. I think it worth a thousand pounds." I can only add my own deep regret that the province did not obtain it for the price asked. About £500 has since been refused for one of its specimens alone!

Abraham Gesner, M. D., F. G. S., mineralogist and geologist, was born at Cornwallis, N. S., of New York (loyalist) stock, on 2nd May, 1797, and died at Halifax, 29th April, 1864. He studied surgery and medicine in London under Sir Astley Cooper and Dr. Abernethy, and then returned to Nova Scotia, settling at Parrsborough. That district was rich in interesting minerals and he soon became

an industrious collector. In 1836 he published his well-known "Remarks on the Geology and Mineralogy of Nova Scotia" which immediately brought him into notice. It was particularly full in its observations on the trap district of the Bay of Fundy. From about 1838 till about 1843-4 he was provincial geologist of New Brunswick, and established at St. John the Gesner Museum, afterwards purchased by the Natural History Society of New Brunswick. Returning to Cornwallis, he wrote "New Brunswick, with notes for Emigrants" and "Industrial Resources of Nova Scotia". In 1850 he removed to Sackville, N. B., and in 1852 to Halifax. Two years later he patented a process for extracting an illuminating oil from coal and other bituminous substances, which he at first called 'keroselene,' a name subsequently shortened to kerosene. After 1855 he devoted much of his time to the production of kerosene oil, lived in the United States, and published in 1861 his 'Coal, Petroleum and other Distilled Oils'. He finally returned to Halifax in 1863. He was a fellow of the Geological Society of London (1840), corresponding member of the Royal Geographical Society of Cornwell and of the Academy of Natural Sciences of Philadelphia, and member of the Georgraphical Society of New York. He and Webster were the first students of science who had been born in the province. [See Gesner, A. T.: Gesner Family of New York and Nova Scotia, Middletown, Conn., 1912, pp. 11-13; Gesner, G. W.: Dr. Abraham Gesner, a biographical sketch: Bulletin of the Nat. Hist. Soc. of New Brunswick, vol. xiv, (1896), pp. 1-11, with portrait; Matthew, G. F.: Abraham Gesner, a review of his scientific work: Bull. Nat. Hist. Soc. New Brunswick, vol. xv (1897) pp. 3-48.]

William Bennet Webster, M. D., M. P. P., mineralogist, a man of lesser scientific note, was born at Kentville, N. S., 18th January, 1798, and died at Halifax, 4th April, 1861. Like Gesner he gave his spare moments to col-

lecting and studying our minerals, particularly those of the trap district, of which he formed a large collection of choice specimens which his widow presented to the Provincial Museum. He was the discoverer of the interesting fossil which Dawson named *Dictyonema websteri* in compliment to him. He was member of Assembly for Kings County, and is reported to have been a Fellow of the Geological Society, but this I doubt.*

Richard Brown, geologist and mining engineer, was born at Lowther, Westmorland, England, on 2nd May, 1805, and died at London, 30th October, 1882. After experience in the coal-mines of his native country, he came to Nova Scotia in 1826 to report on and open up collieries in Cape Breton for Messrs. Rundell, Bridge and Co., and the newly organized General Mining Association, having been recommended for the work by the then Earl of Lonsdale. He began operating the Association's mines on 1st January, 1827. Subsequently he went to England, and then was stationed at Halifax till about 1839 when he returned to Cape Breton and was agent and general manager of this Association at Sydney Mines, with jurisdiction extending also to the Albion Mines in Pictou County, till his final departure for England on 1st July, 1864. He wrote much on the subject of the geology of the Cape Breton coal formations, and his elaborate work on the 'Coal Fields and Coal Trade of Cape Breton' (1871) is still a standard authority, has been reprinted, and the first edition sells for a large sum. In conjunction with Mr. Smith he contributed in 1829 a chapter on the geology of Nova Scotia (chiefly the eastern part) to Haliburton's 'Nova Scotia'. Many of his papers appeared in the earlier volumes of the Journal of the Geological Society

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* Moses Henry Perley should be referred to here. He was a native of New Brunswick and was born in 1804, and died in 1862. His writings mostly refer to his own province, but in 1851 he published at Fredericton, N. B., a "Catalogue of the Fishes of New Brunswick and Nova Scotia," which more directly connects him with natural history work here. (See Dict. Nat. Biog., vol. 45, p. 9.)

of London. He also published at London in 1880, an interesting volume of 142 pages, entitled "Notes on the Northern Atlantic for the use of Travellers", which contains many natural history observations. He likewise is the author of a well-known 'History of Cape Breton' (1869). He was a fellow of the Geological Society of London, as well as of the Royal Geographical Society.

Sir John William Dawson, geologist and palæontologist, born at Pictou, 1820, and died at Montreal, 1899, has become so famous in the world of science, that I will barely mention him here; and he furthermore belongs to a later period than would rightly place him among the pioneers. It will merely be noted that the visit of Sir Charles Lyall in 1842 filled him with enthusiasm and thereafter he began a long series of geological and palæontological works, chief of which, to us at least, was his 'Acadian Geology'. In 1848 he prepared a little 'Hand Book of the Geography and Natural History of Nova Scotia,' third edition in 1852, which is of interest as being one of the first works to give anything like a general scientific list of our fauna. It had been preceded in this respect, by the lists in the second volume of Haliburton's "Nova Scotia," 1829, which were supplied by various persons.

There are four others, who although but visitors to the province, gave a most marked impetus to the study of local geology and mineralogy. In May, 1826, Francis Alger of Boston visited Nova Scotia and in the next year published his "Notes on the Mineralogy of Nova Scotia" (Silliman's Journal of Science and Arts, vol. 12, June, 1827, p. 227); and in 1828 and 1829 appeared Charles T. Jackson and Francis Alger's elaborate "Description of the Mineralogy and Geology of a part of Nova Scotia" (Silliman's Journal, vol. 14 [July, 1828], pp. 305-330, with geological map; vol. 15 [Jan. 1829], pp. 132-160, 201-217). This coloured geological map is the first we had. Their work profoundly affected the in-

vestigation of our formations and was undoubtedly the incentive which induced Gesner and Webster to devote their leisure to such studies.

In 1841, Sir William E. Logan made a tour of Nova Scotia, which he described in a paper, and two years later he measured the fine South Joggins section. In 1842, Sir C Charles Lyall came here, and one thing he did was to place our local observers in touch with other workers. He and Logan were the men who encouraged Dawson to take up his life's work..

The Halifax Mechanics' Institutf.

In tracing what led up to the foundation of the Nova Scotian Institute of Natural Science, we must go back to the time when mechanics' institutes became popular and held their sway for a quarter of a century or more.

The first Mechanics' Institute, properly so called, was organized in Glasgow by George Birkbeck in 1823, being followed in 1824 by that at London. From them soon sprang many others, on a wider basis, the original idea having been merely to teach mechanics the principles of their trades. From these institutes have arisen various technical and other organizations.

The Halifax Mechanics' Institute was established on 27th December, 1831, at a meeting of the shareholders of the Halifax Mechanics' Library. It was affiliated with that organization, which had been established on 17th October of the same year, and all Institute members had to financially support the Library. The Institute's objects were the cultivation and diffusion of knowledge in the arts, sciences, and general literature, and the collection of models, drafts, specimens, books of reference and other materials tending to instruction and improvement*. The original officers were: Dr. William Grigor, president; John Leander Starr and

* The annual meeting for the election of officers, etc., was held on the last Wednesday of December, until February, 1838, when the date was changed to the first Wednesday in May.

Joseph Howe, vice-presidents; William M. DeBlois, treasurer; John Sparrow Thompson, secretary; and Robert Lawson, procuror of models, etc. (curator). Dr. Grigor held office till 23rd December, 1833. The subsequent presidents were, Joseph Howe (Dec. 1833 to Dec. 1834), John Leander Starr (Dec. 1834 to Dec. 1835), George Rennie Young (Dec. 1835 to Dec. 1837 or May 1838), Andrew McKinlay (from Dec. 1837 or May 1838 to May 1849), Dr. Daniel McNeil Parker (May 1849 to May 1852), Rev. Dr. Alexander Forrester (May 1852 to May 1855), Andrew McKinlay (May 1855 until his death, 29th Sept. 1867), after which the presidency was vacant, but James Thomson continued as vice-president until about the autumn of 1868.*

Meetings for lectures were held once a week during the session, and a museum was immediately established and gradually grew. The museum was at first in the same room as the library, namely the lower part of the premises occupied by Mrs. Grover as a boarding house, in Hollis Street. Subsequently gatherings were held, and the collections accomodated, in two rooms in the west end of Dalhousie College on the Parade.

The Institute became very popular and a most interesting series of lectures was given, by prominent local men, on scientific subjects, the fine arts, literature, etc., and art exhibitions were held, all of which were well attended.†

Gradually, however, doubtless in the '50s, the interest in it began to wane, and about 1860 it had become more or less dormant and finally became defunct as far as active work was concerned, leaving its museum, with old Errol Boyd, the curator since 1847, as the only tangible remains of its former glory. From that time the old officers appear to have just continued nominally in office, their places not being filled up as death took one after another, until in 1868 there

* The presidential dates I believe will be found accurate, but absolute verification has not been made in all cases by reference to newspaper files. The record books of the Mechanics' Institute are not known to be in existence.

† In 1845 a Mechanics' Institute building was erected in Dartmouth, N.S.

remained only a vice-president, a treasurer, a curator, and five committeemen. In that year the trustees handed over the collection to the Provincial Museum, which action finally closed the history of the society.

It may be mentioned that about 1839 a society known as the Halifax Literary and Scientific Association was in existence, with W. C. Silver as president, and it at least survived till the next year, but I know nothing further of its history. (See Belcher's Almanac for 1840).

The Nova Scotian Institute of Natural Science.

In 1859 the Nova Scotian Literary and Scientific Society was doing some active work, no doubt formed, about then, from the salvaged wreckage of the Mechanics' Institute, and with objects intended to save the new association from running on the rocks which had caused its predecessor to founder. It published its Transactions for the period from 4th January to 3rd December, 1859, (Halifax, 1859), probably not more. In the next year Dr. Charles Cogswell was its president, being followed by Robert Morrow; and in April 1862, I believe, J. R. Willis read before it a paper on our shells.

There seems to have been various interests working in this society, which possibly did not harmonize, and the scientific men proposed to form an organization that would be all their own.

In February, 1861, the second International Exhibition of London received its charter and was opened on 1st May of the following year. Nova Scotia had been rapidly coming into notice. Coal was being largely produced, iron was being mined, and gold had lately been discovered, and it was considered to be a favourable opportunity to bring our natural resources before the eyes of the world. Specimens for the purpose were collected with much enthusiasm and were forwarded to London. Those who had been engaged

in this work, felt the need of more scientific help and fuller information regarding our animal, vegetable and mineral resources. Thus was suggested the necessity of a permanent organization that might foster the scientific spirit among us. In other words, a few men of scientific tastes had individually devoted energy to studying our fauna, flora and geology, but it was felt that they should have a technical society of their own to publish the results of their observations. The Mechanics' Institute was dead in all but name, and had not been exactly on the lines now required. The recently formed Literary and Scientific Society formed a basis for a new structure. The scientific members were more energetic for the time being, and dropping the purely literary element, decided to form a society which would confine its activities to science alone.

General Hardy, the only survivor of those present at our inaugural meeting, writing on 20th January, 1913, says, "I remember well the friendliness and hearty co-operation of our efforts to set forward the development of local knowledge of the natural history and resources of the province. We were a band of enthusiastic lovers of nature: hunters and woodsmen, zoologists and geologists, botanists and fishermen, historians and antiquarians, each zealous of improvement in his own particular sphere of knowledge or science."*

Several preliminary meetings were held in the office of Robert G. Haliburton, Barrington Street, and a roster of prospective members was made out on 26th December, 1862, at one of these meetings held to talk over the matter. Finally on the 31st of that month (1862), at a general meeting held

* W. Gossip says "The Institute originated with a few gentlemen who believed, that in a province which contained vast mineral resources, and further was an untrodden field in other branches of natural science, there would be found men of culture and experience who would gladly lend their aid to develop them into successful activity." (Trans., vi, p. 157; see also Lawson, Trans., ix., p. viii).

in the hall of the Medical Society at Halifax,* there was organized the NOVA SCOTIAN INSTITUTE OF NATURAL SCIENCE.

At this meeting John Matthew Jones was in the chair, and there were also present Thomas Belt, Samuel Gray, Dr. John Bernard Gilpin, William Gossip, Robert Grant Haliburton, Captain Westcote Whitechurch Lyttleton, Henry Poole, Captain Campbell Hardy, R. A., John Robert Willis, and Philip Carteret Hill.

What took place is told in the manuscript minutes:

"The chairman read a draft of the bye-laws that had been prepared by the council, and intimated the desire of the council and officers that there should be a fresh election, and the resignation of the present office-holders and members of council should be accepted.**

"Capt. Lyttleton and Mr. Haliburton reported that they had waited on His Excellency, the Lieutenant Governor, who had consented to act as patron of the society.

"It was moved by Mr. J. M. Jones, seconded by Dr. Gilpin, that P. C. Hill, Esq., be president for the ensuing year; which passed unanimously.

"Moved by T. Belt, seconded by Capt. Lyttleton, that J. M. Jones and R. G. Haliburton be vice presidents for the ensuing year; which passed unanimously.

"Resolved on motion of Capt. Lyttleton, seconded by J. M. Jones, that the following gentlemen compose the council for the next ensuing year: Dr. Gilpin, Rev. J. Ambrose, Henry Poole, Captain Hardy, T. Belt.

"Also resolved on the motion of Dr. Gilpin, seconded by J. M. Jones, that J. R. Willis and J. B. Young be secretaries of the Institute.

"Resolved on motion of J. M. Jones, seconded by Dr. Gilpin, that Capt. Lyttleton be treasurer for the ensuing year.

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*The Medical Society of Halifax originated in 1854.

**This doubtless refers to the officers and council of the N. S. Literary and Scientific Society.

"Resolved that the next monthly meeting be held on the 19th January and afterwards at the regular time on the first Monday of each month; also that the secretaries make enquiries as to procuring the Mechanics' Institute room at Dalhousie College for monthly meetings, or some other suitable place.

"Resolved that at the next meeting each member be entitled to bring a friend.

"The bye-laws, with some slight modifications, were unanimously adopted."

According to the bye-laws, monthly meetings were to be held for the reading and discussion of papers relating to natural science, and four field meetings were to take place annually. The Institute was to "undertake the publication of lists of the various natural productions of the province, with such observations as their respective authors may deem necessary. That, as far as the funds of the Institute will permit, the president's address, the list of native productions, and a selection of the papers read at the meetings by members be published as the 'Transactions of the Nova Scotian Institute of Natural Science' and distributed gratuitously to the members."

The admission fee was 20 shillings (afterwards $4.00) and the annual subscription 10 shillings (afterwards $2.00), The election of associate members was authorized in October, 1863, with an admission fee of 10 shillings and an annual subscription of 5 shillings.

Those whose names appear on the original roll as elected "26th December, 1862," and who must be taken as the original members, with three exceptions afterwards referred to, are as follows:—Rev. John Ambrose, M. A. (St. Margaret's Bay); J. Bernard Gilpin, M. D.; J. R. Willis, (name scratched out and marked "retired Dec. 1863"); Thomas Belt; Capt. C. Hardy, R. A.; Andw. Downs; R. G.

Haliburton; Capt. Westcote Lyttleton; J. Matthew Jones; Samuel Gray; Colonel [W. J.] Myers; Wm. Gossip; Lieut. [Francis] Duncan, R. A., (Canada); J. Young; Rev. Alex. Forrestor, D. D., (Truro, marked "erased for non-payt. adm. fee"); H. G. Flint (Yarmouth); W. Lyttleton; P. C. Hill; Dr. Gesner (New York); Prof. How, D. C. L. (Kings College, Windsor); Rev. D. Honeyman (Antigonish, name erased); Henry Poole; J. Hunter Duvar; and Rev. Dr. Cramp (Wolfville). All were of Halifax or its vicinity, except those otherwise mentioned. There are columns for "date of election" and "date of admission" (the latter not being filled in). I think the "date of admission" was the time when a man qualified by the actual payment of the admission fee. The dates given in the earlier printed lists seem to have been the latter ones, and therefore do not indicate the date of election, which has produced some confusion in our ideas of when a man joined the Institute. If these dates were accepted, we would be in the peculiar position of believing that the society had no members when it was organized. As the first council minute-book is missing, we find it impossible after 1864 to say exactly when a member was elected and sometimes have to take the time when the fee was paid. There can be no doubt whatever that of those mentioned in the preceding list, the following did not pay admission fees, and cannot therefore be considered as original members: Lt. Duncan, Rev. Dr. Forrester, and Rev. D. Honeyman, the latter coming up again for election and being admitted on 3rd December, 1867. We also find that Dr. Gesner was re-proposed on 2nd November, 1863.

At the first ordinary meeting, held at Dalhousie College, on 19th January, 1863, Dr. J. B. Gilpin had the honour of reading the first paper, viz., on "The Common Herring of Nova Scotia," followed by one by Captain (now Major-General) Hardy, R. A., on the "Nocturnal Life of Animals

in the Forest". General Hardy, I am greatly pleased to say, is still living, at 3 Victoria Park, Dover, and has reached the age of eighty-one years. He takes a deep interest in all our affairs and is our sole surviving original member.*

At the February meeting, at which the patron, the Earl of Mulgrave, was present, and spoke at some length, the president, P. C. Hill, D. C. L., read an address. Hill, who was then mayor of Halifax and a prominent gentlemen of the time, attended only this one meeting and was probably merely a figure-head, being succeeded in October, 1863, by J. Matthew Jones, since when the society has had, as its presiding officer, men who have been directly interested in scientific work.

In April, 1863, the place of meeting was changed to the "Institute Room" in the Province Building, the use of which was given by the government, where it assembled till May, 1871. From October 1871 till April 1887, it met in the Provincial Museum; then for a short while in the Provincial Engineer's office, Provincial Building; from December 1888 to April 1890 in the Art School; and thereafter mostly in the Legislative Council Chamber and Assembly Room, and

* Major General Campbell Hardy, late R.A., was born at Norwich, England, on 10th October, 1831, son of the Rev. Charles Hardy, M.A. He was educated at the Royal Military Academy, Woolwich. He entered the Royal Artillery as ensign on 19th December, 1849; became lieutenant on 11th August, 1851; and captain on 23rd February, 1856. He served in Nova Scotia from February, 1852, to August, 1867, five and a half years of which period he was Inspector of Warlike Stores and Firemaster. In 1866-7 he was also Inspecting Field Officer of the Nova Scotia Militia Artillery. While in Halifax he lived on Robie Street (Camp Hill). In 1869 he published in London his "Forest Life in Acadie", a work which is very highly valued for its accurate and delightfully written accounts of forest life and sporting adventures, he being a most ardent sportsman and lover of nature, as well as a skilful artist. He was commissioned major on 5th July, 1872; lieutenant-colonel, 16th Jan., 1875; colonel, 16th Jan., 1880; and was retired on full pay on 29th May, 1880, with the honorary rank of major-general, and now resides at Dover, England. Outside of his period of service in Nova Scotia, his life has been somewhat uneventful, but he has given much of his time to his favorite studies and sport. He looks back upon his Acadian forest experiences as the most delightful phase of his past. He published in our transactions six papers, viz., on Nocturnal Life of Animals in the Forest, The Capelin, Provincial Acclimatization, The Beaver in Nova Scotia, Nova Scotian Conifers, and a Nova Scotian Naturalist (Andrew Downs). To illustrate his paper on the beaver, he prepared a most carefully constructed model of a beaver house in 1866, which was shown at the Industrial Exhibition, Paris, 1867, and is now in the Provincial Museum.

finally on 13th December, 1909, it began to meet in the Technical College.

One of the pleasant features of the early years of the Institute were the field-days which were held in the summer. Although the bye-laws called for four annually, it was not found possible to have so many. The first was held on 11th June, 1864, at French Village, St. Margaret's Bay, to investigate some Indian shell-heaps, and on 21st of the following September one took place at Cole Harbour for the same purpose. In 1865 the members drove to the Waverley gold mines on 1st July; and on 26th June of the next year, a pilgrimage was made to the grave of Titus Smith in the woods near Dutch Village, where an interesting paper was read on that naturalist's life and work, and the president's museum at "Ashburn" was also inspected. From then till 1870 no excursions took place, although it was announced that one would be held on 28th June of the last-mentioned year in the vicinity of St. Margaret's Bay to explore shell-mounds there. On 21st June, 1871, a field-day took place at the Montagu gold mines, and another on 24th August, 1876, at Grand Lake. The last ones took place on 3rd and 24th August, 1878, at Point Pleasant and York Redoubt respectively. Since then they have been often proposed, but never carried out. They were enjoyed at the time, and gave members an opportunity of becoming acquainted with natural history in the field, under the guidance of competent leaders. They are now, at least, unpopular, perhaps because of the greater stress of present-day business life. Other societies are meeting with similar troubles in Nova Scotia; although in Ottawa and Montreal, field excursions are still kept up, as well as in England.

William Gossip, writing thirty-six years ago (October, 1876), says, "At the formation of the Institute it was supposed that these excursions would be generally taken advantage of, as pleasing and popular features of our proceedings.

In no one year, however, since that time, has there been found much enthusiasm in their behalf or willingness to engage in them. This may be attributed to the fact that each member of the Institute considers his public or private business of paramount interest, and the pursuit of science in this way quite a secondary object. I often think it a pity that it should be so at all times, and that we lose a large amount of knowledge and profitable recreation by not attending to these pleasant meetings."

The first part of the society's "Proceedings and Transactions", for the session of 1862-3, was published about November, 1863; and the first volume (for 4 years) was completed and its title-page issued in 1867. It contained articles on zoology by Gilpin, Jones, Ambrose, Willis, Belt, Downs, Duvar, and Sinclair; on anthropology by Haliburton and Gossip; on botany by Lawson and Hardy; on geology and mineralogy by Belt, How, Gossip, Honeyman, Jones, Hamilton, and Morton; on palæontology by Poole; on metallurgy by Gesner; and on meteorology, by Myers.

The earlier volumes were edited by its secretary and president, William Gossip, whose long experience in publishing assured good proof-reading and typographical style. In this work he was succeeded by Dr. Honeyman from about 1887 till 1889, whose eye for such work was not so well trained; then by Dr. MacGregor till 1901; by Piers till October 1908; and then by Dr. Creighton and Dr. MacKay.

In looking over the earlier lists of members, a noticeable feature is the number of army men who joined and often assisted in the active work of the society and by contributing papers. Pre-eminent among these was our vice-president, Captain (now Major-General) Hardy of the gunners, the author of that delightful work, "Forest Life in Acadie" (Lond., 1869), a book which now brings a large price. He was a charming writer, a keen sportsman, a good zoologist and woodsman, and a skilful artist.

Among other service-men were Capt. W. W. Lyttleton; Col. W. J. Myers; Lieut. F. Duncan, R. A.; Capt. C. L'Estrange, R. A. (who served on the council); Lt. Col. M. Clifford, R. A.; Capt. J. R. King, R. A., (on council); Major D. L. Colthurst, 17th Regt., (on council); Capt. W. D. Thompson, 17th Regt., (on council); Lieuts. H. C. Deane, (member of council), and L. F. W. Dwyer, 17th Regt.; Lieut. H. H. Webber, R. A.; Lt. Archibald Anderson, R. A.; Capt. Tulloch; Lt. C. Morley, R. A.; Lt. H. J. Hope Edwards, 60th Regt.; Lieut. Hon. A. H. Fulke Greville, 60th Regt.; and others, most of whom belonged to the artillery and were probably brought in largely by Capt. Hardy. With the exception of Surgeon Capt. Barbour, we have lately had no recruits from this source, although invitation cards have been sent to the army departments for a number of years. As a matter of fact, the army man has changed in more senses than one since the first years of the society, and strange though it may seem, the abolition in 1871 of the old purchase system seems to have had something to do with it.

We have referred to the field-meetings of the Institute, but there was another style of entertainment that was indulged in on two occasions, and on each was successful and well attended. On 6th July, 1865, a conversazione was held in the hall of the Horticultural Gardens, at which about two hundred persons were present. Popular scientific addresses were given and refreshments served. Another of like character was held on 20th January, 1873, in the Provincial Museum and appartments of the Post Office, with His Excellency Sir Hastings Doyle in the chair, and about the same attendance. It was the last that took place.

The Provincial Museum had been established about October, 1868, through the strenuous exertions of some of the prominent members of the Institute, and it became the repository of all specimens that were donated to the society,

including many which illustrated papers read before it. Further reference will be made to this later on.

About 1867 a grant of $200.00 was first received by the Institute from the Provincial legislature, and $100.00 was granted in each of the two succeeding years at least. The Legislature for many years financially aided the, society, and in 1890 this grant was raised from $400.00 to $500.00 to meet the cost of printing a thousand copies of the Transactions.

It should be noted in passing, that in the winter of 1872-3 the sessions of a so-called School of Science were held in connection with the Provincial Museum, Dr. Honeyman lecturing on zoology; and that on 1st March, 1878, there was established at Halifax a Technological Institute, for instruction in technical subjects, of which Prof. Lawson was president, Dr. Somers, vice-president, and Dr. Honeyman, secretary and treasurer, with a competent corps of instructors, nearly all of whom were members of the Institute of Science. It had a class-room in the Stairs building, 74 Bedford Row, but some classes were held in the Museum and elsewhere. After three sessions, it passed out after May, 1880, for lack of funds. It was the unsuccessful forerunner of the present Technical College, and yet I never heard its name mentioned during all the agitation leading up to the foundation of the latter institution.

The visit to Halifax in May, 1873, of H. M. S. *Challenger* with Prof. Wyville Thomson on board, gave our members an opportunity of becoming acquainted with the most modern and improved methods of marine research, and stimulated such as were interested in that subject, as did also the sojourn here, from August to October, 1877, of the U. S. Fish Commission's ships with their corps of specialists.

The year 1874-5, unfortunately, is spoken of as our year of greatest intellectual dearth, judging by the small number of papers submitted, namely eight, (*vide* MacGregor's

address, 12th November, 1888). The average yearly number since 1862, has been between ten and eleven; and the average length of each paper, eleven pages. For the first twenty-five years, the average number of papers was about twelve, and the average length, nine pages.

On 2nd April, 1879, the Institute of Science was honoured by having its then and subsequent presidents made *ex-officio* Fellows of the Royal Microscopical Society, a distinction which our presiding officer still enjoys.

In the year just mentioned, the Institute deliberated on a collection of supposed rude, prehistoric pottery discovered in the water of Grand Lake. The few who had their doubts, were afterwards proved to be right when more careful investigation showed that they were merely disk-like concretions of iron and manganese oxides about a nucleus of quartzite! It is one of the very few little episodes of a semi-laughable kind we have to look back to.

On 5th and 15th October, 1884, a revised constitution and bye-laws were adopted. With the exception of the addition of a curator or librarian to the list of officers, the changes from the older bye-laws and unwritten laws were not material.

The session of 1888-9 was an epoch-making one in the annals of the society. Dr. James Gordon MacGregor was elected president on 10th October, 1888, and held office till November, 1891. It was a period of regeneration. A month after taking the chair, he gave a masterly address on the Institute's affairs—the first of the regular series of annual presidential addresses which we have since had, the older contributions of the kind having been at rare intervals. He carefully analysed the society's history, found that the period of greatest activity was the first few years of its existence, and that since 1867 it had kept oscillating with an average of about eleven papers a year. The lowest ebb, as has been remarked, was in 1875. About 304 papers had been pub-

lished down to 1888, a period of twenty-six years, mostly on the natural history and geology of Nova Scotia, and averaging about nine pages each.

It was felt that the society's activity had reached a critical point. Progress was not being made, activity was decreasing; some of the most energetic members had died and few young men were ready to take their places. He admitted that in the early history of a country it is comparatively easy to make additions to the knowledge of its natural history and geology. He thought, however, that scientific education in the province had not kept pace with scientific investigation.

He attacked the whole problem with all the energy and extreme keeness of intellect for which he was noted, and placed the Institute on a higher plane than it had been. Perhaps we may have to wait for another MacGregor to tackle the problems that now face us!

One result of MacGregor's exertions was the phenomenal growth of the library, which will soon receive notice. In 1890 he increased the edition of the Transactions to 1000 copies, which were sent in exchange to learned institutions and libraries over the whole world, thus making our volume a more acceptable means of gaining a hearing for our most-known workers who had begun to think that publication of their papers in more-widely circulated journals, which welcomed them, was an advantage. This enlarged edition was of great benefit to us in another way, as it was the means of rapidly building up our library by the much larger number of exchanges which were thereby received.

Another result of MacGregor's ideas of the needs of the case, was that on 24th March, 1890, at a general meeting, the name of the society was changed to the NOVA SCOTIAN INSTITUTE OF SCIENCE, an action which was opposed by ex-president Somers and a few of the old members*. The

*The Society was incorporated by act of the N. S. Legislature in the same year, 1890.

dropping of a single word is but a little matter in itself, but it widened the scope of the society to a large extent. It was felt that while "natural science" was retained in the name, others would consider it to be merely a natural history association, and it was found difficult to get general scientific organizations to exchange with it. It was also thought that no limitations should be be placed on what the society should consider its field. As a result of this change, we have since had a number of papers on physical and chemical subjects, etc. I am aware that one of the most learned biologists of the United States regrets very much that we have departed from our old tradition of admitting only papers which have a manifest local bearing, leaving such purely technical papers as have been mentioned for the special journals which are devoted to such subjects.

Down to the time now under consideration, the Institute had had the field of science in Nova Scotia all to itself, for the Gold Miners' Association of about 1884 published little or nothing. On 30th March, 1892, however, the Mining Society of Nova Scotia was organized, absorbed the Gold Miners' Association, and began to publish its yearly "Journal." Although all of the papers which appear in the latter might not, possibly, be suitable for the Institute, yet there is no doubt it has deflected to itself a number of contributions which we would be glad to have had.

In December, 1906, the engineers formed an organization of their own, known as the Nova Scotia Society of Engineers; but publication so far does not seem to have been adequately taken up by them. It is to be hoped, perhaps, that some sort of affiliation may be possible among these various societies.

The foundation of the Royal Society of Canada in 1882 has also had a marked effect on the production of our Institute, as many papers on Nova Scotian subjects have appeared in the more notable society's publications, which otherwise would have been given to our own.

All of these influences have undoubtedly worked to the detriment of the Nova Scotian Institute.

A condition of affairs arose in 1901 which it was thought might bring good results. Members of the Institute in the university town of Wolfville, under the enthusiastic leadership of Prof. Haycock and other members of the college staff, expressed a desire to form a sub-organization. It was thought to be a good time to form affiliated branches throughout the province which would be of mutual benefit to all concerned.

Accordingly on 28th May, 1901, the KING'S COUNTY BRANCH OF THE INSTITUTE was organized at Wolfville, with Prof. Haycock as president. Associate members were permitted to join the branch for a nominal fee of twenty-five cents a year. It was very successful at first, held four annual sessions and read or discussed papers of interest, but ceased to exist after the session of 1903-4.

The summer of 1901 saw the departure of Dr. MacGregor for Edinburgh University to take the chair of natural philosophy there, and the Institute joined with others in a farewell dinner to the man who had done more than yeoman service for our society. While appreciating and delighting in the well-deserved honour that had thus come to one of the province's most talented sons and one of our fellow members, the whole society could not but deeply feel his loss. Possibly I may be pardoned for expressing my own humble opinion that his is the keenest intellect that Nova Scotia has produced.*

I shall not proceed further with a general narrative, as the past decade is clear in all of our minds, but will give a few particulars of the growth of the library and of the museum, and then concise sketches of the presidents and other men foremost in the society's affairs. In respect to the biographical notes, Sidney Lee, editor of the "Dictionary of National

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*The sudden death of Prof. J. G. MacGregor. D. Sc . LL D.; F. R. S.; F.R.S.E., F.R.S.C., at the age of sixty-one, took place at Edinburgh in May, 1913, a few months after the preparation of this paper.

Biography," says (and he should know) that no biography can or should be written until the culminating point, death, has closed the record. There are also other self-evident reasons why I will confine myself, in the biographical section, to merely remarks on those worthy labourers who have passed to rest.

The Library of the Institute.

Although the acquisition of a library was no doubt in the minds of the original members in 1862, yet the earliest mention of a collection of books being formed is in March, 1864, when was announced the receipt of the first book donations to the institution, viz., the Second Report of the Scientific Survey of the State of Maine, and the Report of the Natural History Society of Newcastle-upon-Tyne. Such was the modest beginning of a library which now contains nearly 36,000 books and pamphlets. For some twenty-five years, society journals were very slowly added by exchange. It was not until the revision of the bye-laws in 1884, that a librarian was considered at all necessary, to which office A. J. Denton was elected on 21st October, 1885, which position he held for four years. When I first remember the library about 1887, it was contained in about three small book-cases in the hall outside the Provincial Museum, which was then situated on the top floor of the Post Office. I know, however, that even the few scientific journals it then had, gave me as a lad the keenest pleasure in perusing them. In 1888 the books were put in order and binding to a larger extent was begun.

Feeling that the possession of a good library of society periodicals was one of the principal requirements of a scientific institution for research, if its members hoped to keep abreast with progress elsewhere, Dr. MacGregor, during his energetic presidency, with the assistance of Mr. Bowman, the librarian, devoted much attention in 1889 and 1890 to

increasing the exchange-list, and with this end in view the edition of our "Transactions" was in 1890 increased to one thousand copies, and the question of dealing adequately with the binding of exchanges was actively taken up. (See MacGregor's Address, 8th October, 1890.). In November, 1889, the Institute exchanged with only about one hundred institutions, but steps were being taken to increase this number to three or four hundred, and this was ultimately brought up to seven or eight hundred.

The library then began to grow by leaps and bounds. Very soon it could not be accommodated in the Post Office hall, and in 1894 the foreign section of it was removed to Dalhousie College and eventually all of it, where MacGregor had it constantly under his eye, sharing with Mr. Bowman the great labour connected with its management, labour which was given willingly and gratuitously by these otherwise busy gentlemen.

Still it grew till it soon was beyond the capabilities of a small society with limited means, to look after it properly. Seeing that such publications, from every quarter of the world, and containing the very latest results in science, were of use to the whole province and not only to a limited few, the Institute by letter to the Provincial Secretary, dated 21st December, 1899, stated its willingness to intrust its library to the custody of the government (the right of property remaining with the society) on condition that it "should be made the nucleus of a public library to be maintained by the government in connection with the Provincial Museum, and to be open to all who may wish to use it, under such restrictions only as might be necessary for the safe-keeping of the books," and also on condition that the government appoint "a competent librarian to take the library in charge."

The government saw the wisdom of acquiring these books under the conditions laid down, and the result was the foundation of the PROVINCIAL SCIENCE LIBRARY OF NOVA

Scotia in the summer of 1900, under control of the Department of Public Works and Mines. The scientific works of the Legislative Library were passed to it in July and the transfer of the Institute's books from Dalhousie College was begun on 17th November, while manuals, textbooks, etc., were added by the government by purchase, and the whole was thrown open, free, to the public of the Province, soon after, thus becoming the first public library for the whole of Nova Scotia. The Mining Society also deposited its books there till February, 1907, when it fitted up a room of its own. A government grant of $500 a year for the support of the Science Library was given up to 1904; but after that, was withdrawn, and I regret to say that it is now without direct financial support.

Having utterly outgrown its quarters in the so-called Burns and Murray building on Hollis Street, the library was removed in May-June, 1910, to a new and larger stack-room in the Technical College.

On 31st December, 1911, it contained 45,497 books and pamphlets, of which 34,085 (about 75 per cent.) belong to the Institute. The average yearly increase to the society's library is 1,841; and to the Science Library proper, 1,099; a total average yearly increase of 2,940.

The Provincial Museum.

Dr. A. H. MacKay has aptly spoken of the Provincial Museum as "the ward of the government, but the child of the Institute." The society has always taken a very vital interest in it, for it was formed at the solicitation of its members, and it has always deposited in it such specimens as were donated to it, so that in one way it is the Institute's museum in part, although under control of the government.

The origin of the collections it contains goes back to 1831 when the old Mechanics' Institute began to form a general

museum, which grew until 1860 when it came to a standstill owing to the dormant state into which that society had passed. Its curators were: (1) Robert Lawson, 1831; (2) John Fairbanks, about 1833; (3) John McDonald, 1835-46; (4) Andrew Downs, 1846-47; and its last and best remembered curator, Errol Boyd, (elected in May, 1847), a man, however, not well fitted for the position by education or native talent. The museum remained in Dalhousie College, but was going to pieces from lack of care.

The establishment of a provincial museum was first proposed in 1862, when collections were being made for the London International Exhibition. The Rev. J. Ambrose and J. M. Jones had (about 1861) suggested to J. R. Willis the propriety of taking some steps in the matter, and the first-named gentleman had written a communication upon the subject, to "tune" the newspapers, as he termed it. (Trans., vii, 409, foot-note). Nothing resulted immediately from this agitation. In 1865 Rev. D. Honeyman and J. R. Willis presented a memorial to the government strongly advocating the establishment of such an institution, and Willis appeared before a committee which was to report upon the matter. At the time of the preparation for an exhibit at the Paris International Exhibition which opened in April 1867, Honeyman being secretary of the Nova Scotia Commission, the project was vigorously pushed, with a successful issue. In the beginning of 1866 Dr. Honeyman had proposed to A. MacKinlay, trustee of the Mechanics' Institute, to take the museum of that defunct institution, whose collections were becoming ruinous, and to make it the beginning of a provincial museum. MacKinlay and the other trustee, James Forman, agreed to the proposal. Honeyman then applied to the Provincial Government for accommodation for a museum in the new building (now the post office) which was then in course of erection, and the government agreed to set side a room there for the purpose. The foundation of

a museum being now assured, the Nova Scotia Commission purchased natural history collections with the understanding that they were to be brought back from Paris and deposited in the proposed museum. How, writing in January, 1867, says that a space, 70 by 30 feet, had been set apart for a provincial museum in the province building (post office) then being built.

The Provincial Museum was finally founded in October, 1868, when Honeyman was authorized by the government to take possession of the room, where the Halifax Mechanics' Institute museum (thirty-seven years after its formation) was formally transferred by its sole surviving trustee, James Forman, to the Nova Scotian government and placed in the large room prepared for it in the post-office building. These specimens were incorporated with those which had been at the Paris Exhibition and which had been returned after its close on 3rd November, 1867. The latter included How's minerals and herbarium, Downs's birds, and Barnes's carboniferous fossils. The late Dr. Honeyman was appointed curator and remained so until his death on 17th October, 1889, and the extent of the then collection was largely the result of his zeal. It should be mentioned that to the Hon. William Garvie was due much credit for lending his support to the institution on its formation.

For thirty-one years the museum was of a general character, and after Honeyman's death remained *in statu quo*, but in 1899 the government at the strong solicitation of the Institute of Science, decided to give it more attention and wisely determined to cut it down to a representation of Nova Scotian products only, placing the foreign specimens in storage. In October, 1899, arrangements were begun to remove the collections to the Burns and Murray building, where they soon outgrew their quarters, and in October, 1910, they were finally removed to the Technical College.

When the museum was revised in 1899 there were retained 10,099 of the old specimens. From then till December, 1911, there were added 14,814 specimens, making a total of 24,913, or about 25,000 at the present time. Since 1900 it has received an average of 1,235 specimens each year. Allowing for specimens that had been discarded in 1899 because of lack of data, there can be little doubt that for the twelve years since then, the number of accessions exceeds the total number obtained from 1831 to 1899, a period of sixty-eight years.

In closing these ragged and brief annals of our society, we find that, like those of Miss Mitford's Village, they are somewhat uneventful. I only regret that we have not had a Mitford to lend to our simple story the charm with which her genius invested the daily happenings of her little community.

Biographical Sketches.

One of my chief aims in bringing together these notes, has been, not only to give a few particulars and dates, but especially to present a little about the men, now gone from among us, who laboured for the Institute, for science, and for the country generally, to the very best of their abilities, humble or otherwise, without pay and I fear with but scant recognition of the value of their work. I distinctly feel that at such a time as this, instead of singing too much the praises of the society itself, of which we are more or less a part, we should give a few retrospective glances at the men whose shares first cut the virgin sod, and through whose success we cannot selfishly add one cubit to our height.

With this end in view I have prepared short biographical notes on our deceased presidents and other prominent members, which are appended hereto.

Deceased Presidents.

Hon. Philip Carteret Hill, K. C., D. C. L.—Born at Halifax, 13th August, 1821, son of Capt. Nicholas Thomas Hill, late Royal Staff Corps; died at Tunbridge Wells, England, 14th September, 1894. He was educated at King's College, Windsor, entered the legal profession, and received the degree of D. C. L. from King's College in 1858. Was mayor of Halifax for three years, October 1861 to October 1864; became provincial secretary of Nova Scotia in 1867 and again in 1874; and was premier in 1875, retiring in 1878. He was one of the original members of the Nova Scotian Institute of Natural Science, and its first president, holding office from 31st December, 1862 to 26th October, 1863. He attended only one meeting, and his connection with the society was in all respects slight, his position as mayor at the time doubtless making him a desirable nominal head at the inception of the institute. He was a man of education and literary, but not scientific, tastes, and possessed cultivated manners and financial means.

John Matthew Jones, F. L. S., F. R. S. C., zoologist.—Born at Frontfaith Hall, Montgomery, Wales, 7th October, 1828, son of Admiral Sir Charles T. Jones; died at Halifax, 7th October, 1888. He was educated at the Middle Temple, London, for a barrister, but being possessed of independent means, did not practice. About 1854 he went to New York and soon after came to Halifax, where he decided to reside, his relative, the Earl of Mulgrave, being then governor of the province. He spent sometime in Bermuda where his researches into natural history resulted in the publication, at London, 1859, of "The Naturalist in Bermuda".* At Halifax he resided from October, 1860, for a number of years, at "°Ashbourne," Dutch Village, (which he purchased from his father-in-law, Col. W. J. Myers), and there he had a large

*Günter named *Sygnathus jonesi* and *Gerres jvnesi* (= *Eucinostomus pseudogula*) in his honour; and Goode similarly named *Belone jonesi* (= *Tylosurus acus*). These are Bermudian fishes.

private museum which, in 1866, contained seven or eight thousand specimens. He was an enthusiastic collector and gave generously to various museums. The Nova Scotian fisheries exhibit of the International Exhibition at London, 1862, was brought together under his management. He was an original member of the Institute of Natural Science and one of those who took the most active part in its establishment in December, 1862; he presided at the inaugural meeting, and the society owes a vast debt of gratitude to him for his enthusiastic labours in its behalf. He was its first vice-president, and its second president, serving in the latter capacity for ten years, 26th October, 1863, to 8th October, 1873, the longest presidential term we have had. His studies related chiefly to zoology, more particularly fishes, reptiles, and mollusca, of all of which he left lists, as well as birds, lepidoptera, and marine invertebrates, and the name by which he was jocosely referred to, "Bug Jones," was well known to the last generation. A pretty conceit on his gravestone represents a butterfly above a caterpillar crawling on a twig. His publications number about twenty-three items, 15 of which appeared in our Transactions; and next to Dr. J. B. Gilpin (24 items) he was the most prolific writer the Institute has had on zoological subjects. He was a Fellow of the Linnean Society of London (1st December, 1859 till about 1878), and an original Fellow of the Royal Society of Canada, as well as a member of the Entomological Society of Canada, and corresponding-member of the Natural History Society of New Brunswick, of the New Orleans Academy of Science, and of the Frankfurt Senckenbergische Naturforschende Gesellschaft. (See sketch of life, by H. Piers, Trans., x, p. lxxx, with portrait; List of Fellows of Linnean Society.)

John Bernard Gilpin, M. A., M. D., M. R. S. C., F. R. S. C., zoologist and ethnologist.—Born at Newport, Rhode Island, 4th September, 1810, son of J. B. Gilpin,

formerly of Vicar's Hill, Hants, England, who afterwards retired to Annapolis, N. S.; died at Annapolis, 12th March, 1892. He graduated from Trinity College, Providence, R. I., and took a course of medicine in England, afterwards practising at Annapolis, and spending his leisure in the study of the animal life of the western part of the province. In 1846 he moved to Halifax where he resided for forty years, and then returned to Annapolis where after a period passed in retirement from all mental activities he passed away in 1892. He was an original member of the Institute of Natural Science, and with his friend Jones was one of those who took the most active part in its organization, and his paper on the herring was the first read before it and published in its Transactions. He served as vice-president, and succeeded as the third president on 8th October, 1873, holding office for five years, till 9th October, 1878. He was the society's most prolific writer of the period, his papers, which were long, numbering 24; but some of them being in several parts, 34 would convey a more correct idea of the number of his writings. Dr. Honeyman was the only one who surpassed him in the number of his contributions. Gilpin was a zoologist primarily,* and his papers deal with the mammals, food fishes, wild fowl, the eagles, and our Indians and their remains, and his article on Sable Island is still much referred to. His monographs on our mammals, with full descriptions of their habits, are still, although somewhat out of date, the chief source of information on the subject. Altogether he was probably the best student of the higher animals we have had. He possessed a racey, picturesque and attractive literary style, coupled with close accuracy in his statements and determinations. Furthermore he was a good draughtsman, wielding a ready pencil and brush, which assisted in illustrating his lectures. In

*William Gossip says he was well known in British America and the United States as the Nova Scotian Zoologist (Trans. vi., p. 158).

1882 he was nominated a foundation Fellow of the Royal Society of Canada. (See obituary notice, Trans., viii, p. xlvii; portrait in x, pt. 2.)

William Gossip.—Born at Plymouth, England, in 1809; died at Halifax, 5th April, 1889. He came to Halifax at the age of thirteen, and in 1831 went to Pictou where he published the "Pictou Observer" newspaper. He returned to Halifax in 1834, and established a bookselling and publishing business which was continued till his death. For some years he edited and published "The Times" newspaper of Halifax. He was one of the original members of the Institute and on 26th October, 1863, was elected secretary, holding office till 11th October, 1871, when he was succeeded by Honeyman. The minutes during his secretaryship are very full and interesting and contain items of scientific value which never went into the printed Transactions. From 1871 to 1874 he was a member of the council; from 1874 to 1878, vice-president; from 9th October, 1878 to 13th October, 1880, the fourth president; and from then till 1889 again a member of the council or vice-president. From the establishment of the society, therefore, he took a deep interest in its affairs, and his services were specially acceptable as editor of the Transactions, a duty which he assumed from the first, his knowledge of printing and publishing being valuable for this purpose. He contributed five papers to the Transactions (four anthropological and one geological), besides some addresses and miscellaneous notes. Not being a scientific man by profession, he felt a diffidence in writing on such subjects. The Institute, however, owes him much for long and faithful service. (See obituary by Prof. MacGregor, Trans., vii, 319.)

John Somers, M. D., botanist.—Born in St. John's, Nfld., in 1840; died at Halifax, 13 March, 1898. He came to Halifax in infancy and was educated at St. Mary's College. In 1866 he graduated from Bellevue Medical College, New

York, and spent a year in active service as an assistant army surgeon during the American Civil War, after which he returned to Halifax where he practised till his death. He took an active part in the establishment of the Halifax Medical College in which he was professor of physiology. On the organization of the Technological Institute, Halifax, on 1st March, 1878, he became its vice-president; and in 1883 he was president of the Medical Society of Nova Scotia; besides which he was chairman of the Commission of Public Charities, a school commissioner, and occupied some other positions during his very active life. In January, 1875, he became a member of this Institute, and served for two periods as president, 13th October, 1880, to 10th October, 1883, and 21st October 1885, to 10th October, 1888—the first non-foundation member to be elected to that office. He contributed many papers on his favourite study, botany, including articles on the mosses and fungi, in the latter of which, I think, he was our first investigator. Of his eighteen published papers, 14 relate to botany, 3 to zoology, and 1 to microscopy. His determinations were, perhaps, sometimes too hastily made. He formed a large herbarium, which was, unfortunately, destroyed after his death, which makes a revision of his identifications impossible. (See obituary by Prof. Lawson, Trans., x, p. iii., with portrait; Dr. D. A. Campbell, Mar. Med. News, June, 1910, p. 186.)

Robert Morrow, comparative anatomist and zoologist.—Born at Halifax, 26th July, 1827, son of John and Mary Anne (Duffus) Morrow; died at Halifax, 5th August, 1885. His father came of mining stock from Co. Durham, England, and about 1835 was appointed United States Consul at Halifax, N. S., and later secretary of the N .S. railway. He was fond of studying, in an amateurish way, geology and conchology; and possessed collections of specimens relating thereto. In early life Robert entered the employ of the General Mining Association at the Albion coal mine,

Stellarton, where on the retirement of the manager he was offered that position, but declined it. He then came to Halifax and in 1853 entered the firm of Wm. Stairs, Son and Morrow, which connection he retained till his death, becoming a son-in-law of Wm. Stairs the founder of the firm. He became a man of considerable wealth, was philanthropic, built "Bircham," North West Arm, about 1869, and died there after an illness of several years. Much of his life was given to the study of natural history. He had been, about 1861, a president of the old Nova Scotian Literary and Scientific Society, but for some reason did not join the Institute of Natural Science until February, 1872, but then took an active part in all its affairs, was a member of its council from October 1873 to October 1880, and first vice-president from the latter date till 10th October, 1883, when he was elected president, which office he occupied up to his death. In the basement of his residence he had a small aquarium for studying the habits of fish, speciments of which he regularly received from fishermen. He also had a laboratory or work-room, and to the consternation of his household, he not infrequently kept fish until they were very unpleasant, in order to separate the skeleton, which he and J. M. Jones would study together. He received a prize for his carefully prepared skeleton of an Angler (*Lophius piscatorius*) and of a cod head, which with his collection of West Indian shells are now in the Provincial Museum. His papers on the osteology of *Salmo salar* and *Lophius piscatorius* were masterly productions. He published nine papers in our Transactions, all but one being on the anatomy of vertebrates; but also was interested in general zoology and Indians, and made a special study of Icelandic literature and Norse history.. He read two papers relating to Greenland and Vinland before the N. S. Literary and Scientific Society of Halifax in 1865, which secured his election as a member of the Royal Society of Northern Antiquaries (Copenhagen), and one, "Translation from the French relating to the Religious Beliefs of the Indians prior to the Discovery by Cabot," before the

N. S. Historical Society in June, 1879. He was a corresponding member of the Society of Americanists. (See Morning Chronicle, Halifax, 6th August, 1885; Regan, Sketches and Traditions of North West Arm, 1908, p. 31; Stairs-Morrow Family History, Halifax, 1906.)*

Prof. George Lawson, Ph. D., LL. D., F. I. C., F. R. S. C., botanist and chemist.—Born at Newport, Fifeshire, Scotland, 12th October, 1827; died at Halifax, 10th November 1895. Educated at Edinburgh University, and for a time was demonstrator of botany under Prof. J. H. Balfour and curator of the university herbarium, and prepared a catalogue of the Royal Society of Edinburgh's library. In 1858 he was appointed professor of chemistry and natural history in Queen's University, Kingston, Ont., and thereupon came to Canada. In 1863 left Queen's and took the professorship of chemistry and mineralogy in Dalhousie College, Halifax, a position which he held till his death. He added lectures on botany to those on his other subjects. He had made a study of agriculture before coming to Canada, and was secretary of the Board of Agriculture of N. S. from 1864 to 1885 when the government assumed the functions of the board, and was then appointed secretary for agriculture, remaining such till his decease. He conducted a Journal of Agriculture for twelve years, and published official crop and other reports. Some of the local exhibitions were under his management. He joined this Institute on 7th March, 1864, and in October became a member of council, served as second or first vice-president in 1869-73, 1878-82, and 1891-93, and filled the presidental chair from November, 1893, till his death on 10th November, 1895, being the second president to die in office.

His favorite study was botany, and he was one of the most accomplished students of that subject we have ever had in the province. Of his contributions to scientific societies, etc., from

*Since this paper was prepared, death has suddenly removed one of our most distinguished and most energetic past-presidents, Prof. J. G. MacGregor of Edinburgh University, who at this period was the eighth president, serving as such from Oct., 1888, to Nov. 1891. To no other man's endeavours does the society owe more.

the year 1846 when his first paper appeared, 93 were in botany, 5 in chemistry, 4 in zoology, and 5 were miscellaneous. Besides this he wrote many official reports, a few treatises, etc. To the Transactions of the Institute he contributed some 24 articles, mostly on botanical subjects, some of which were not published. A full bibliography of his writings to the end of 1894, will be found in the Trans. Royal Soc. of Canada, vol. xii. From the University of Giessen he received the degree of Ph. D., and LL. D. from McGill. He was a Fellow of the Botanical Society and of the Royal Physical Society of Edinburgh, and of the Institute of Chemistry of G. B., and original Fellow and president (1887-8) of the Royal Society of Canada,honorary member of the Edinburgh Geological and of the Scottish Arborcultural Societies, a corresponding member of the Royal Horticultural Society (Lond.) and of the Society of Natural Sciences of Cherbourg. (See obituary by Prof. MacGregor, Trans., ix., p. xxiv., with portrait; and by Dr. MacKay in App. B, Proc. Royal Society of Canada, 1896.)

Edwin Gilpin, Jr., M. A., LL. D., D. Sc., F. G. S., F. R. S. C., I. S. O., economic geologist.—Born at Halifax, 28th October, 1850, son of Very Rev. Dean Gilpin and nephew of Dr. J. B. Gilpin; died at Gilpinville, North West Arm, Halifax, 10th July, 1907. Educated at Halifax Grammar School and King's College, Windsor, graduating in 1871; after which he took a special course in mining, geology and chemistry (M. A., 1874). Won the Welsford (1868), General Williams (1869), and Alumni prizes. After leaving college he practised as a mining engineer, being connected with the Albion colliery of the General Mining Association, in Pictou county. On 21st April, 1879, he became inspector of mines for Nova Scotia, in 1881 a member and secretary of the board of examiners of colliery officials, and in October, 1886, deputy commissioner of public works and mines, holding these various appointments up to his death. Was also lecturer on coal mining in Dalhousie College. On 9th November, 1903, he was granted the imperial service order for long and valuable

service, the investment taking place on 23rd March, 1904. He was an extensive writer on his favorite subjects of economic geology and mineralogy; and besides his official reports, published a work on the "Mines and Mineral Lands of Nova Scotia" (1883), and various pamphlets on the minerals of the province, while the Transactions of the North of England Institute of Mining Engineers and of the Royal Society of Canada, and various other societies, contain articles from his pen, all of which did much to make known the mineral resources of his native land. (See bibliography to 1894, in Trans Roy. Soc. Can., xii.). In April, 1873, he joined this Institute, having read before it in the previous month the first paper he ever prepared, and in 1881 became a member of its council and remained in it, either with or without office, till his death. He served as president for two years, 18th November, 1895, to 8th November, 1897. He published in our Transactions 30 papers and addresses, almost entirely on geology and mineralogy. He received the degree of D. Sc. from his Alma Mater, and LL. D. from Dalhousie (1892). He was a fellow of the Geological Society of London (1874), an original fellow of the Royal Society of Canada (1882), member of the American Institute of Mining Engineers and of the Canadian Society of Civil Engineers. (See obituary by Doane, Trans., xii, pt. 2, p. xxxi.; also Journal Mining Soc. of N. S., xiv., p. 103, with portrait.)

Other Prominent Deceased Members.*

Rev. John Ambrose, M. A., D. C. L., zoologist.—Born at St. John, N. B., 25th September 1823; son of Richard and Katherine (Phillips) Ambrose; died at Sackville, N. S., 12th September, 1898. He was born one month after the arrival of his parents from Cove of Cork (Queenstown), Ireland. Although originally from England, his ancestors had resided in Ireland for generations. Was educated at Truro and at

*These sketches are arranged chronologically according to the years in which their subjects became connected with the Institute.

King's College, Windsor, (B. A., 1852; M. A., 1856; D. C. L., 1888). For over forty-four years laboured successfully as a clergyman of the Church of England at St. Margaret's Bay, Digby, etc., and was editor of 'Church Work' and 'The Halifax Church Chronicle'; and also was a governor of King's College. Married, 30th June 1853, at Liverpool, N. S., Charlotte Ann Barss (U. E. Loyalist descent). During a busy life as a country parson, he found in natural history a recreation, although not claiming to be an authority on the subject. He was an original member of the Institute and was proposed as a member of the first council, but as he lived at a distance from Halifax he could take but little active part in its work; and in 1890 was elected a corresponding member. He published six papers in its Transactions, all relating to either the fishes or birds of St. Margaret's Bay, where he was stationed for thirteen years and so had ample opportunity of gathering from the fishermen much information regarding the inhabitants of the deep. (See obituary, Trans. N. S. I. S., x., p. iv.)

Robert Grant Haliburton, M. A., D. C. L., Q. C., F. R. G. S., ethnologist.—Born at Windsor, N. S., 3 June, 1831, son of Judge T. C. Haliburton ('Sam Slick'); died at London (?), March, 1901. Was educated at King's College, Windsor (matriculted 1845; B. A., 1849; M. A., 1852; D. C. L., 1877), and then studied law, becoming a barrister in July 1853, and practised in Halifax. Was secretary of the N. S. Commission for the London exhibition of 1862. From 1871 to 1876 he was in England in connection with some Nova Scotian coal areas in which he was interested; and in 1877 moved to Ottawa. Ill health compelled him in 1881 to give up his practice in Canada, and to spend the winters in tropical or sub-tropical climates, his movements during these times being often not known to his friends for long periods. Since then he devoted his attention chiefly to ethnological investigations, the study of the pigmy races being particularly attractive to him. He

was an original member of the Institute and active in its organization, the preliminary meetings having been held in his office; served as its second vice-president (1862-3), but severed his connection with the society about 1880. He contributed to its early Transactions four papers on ethnological subjects and on the geology and economics of coal. His elaborate paper on 'The Fesitval of the Dead' attracted rather wide attention at the time of its publication. His writings elsewhere were extremely numerous, and a list of them will be found in Morgan's 'Canadian Men and Women of the Time,' 1898, p. 423. He was a fellow of the Royal Geographical Society and of the Royal Society of Northern Antiquaries (Copenhagen), a member of the American Association for the Advancement of Science, etc., and about 1875 was the first colonist by birth to be elected to the council of the Royal Colonial Institute.

Colonel William James Myers, F. R. Met. Soc., meteorologist.—Born, doubtless in Scotland, about 1807; died at Halifax, 15 April, 1867. Myers had been major of the 71st Regiment of Highland Light Infantry which had served in Canada, Bermuda and the West Indies from 1824 to 1846. He received his captaincy on 29th December, 1835; his majority on 22nd November, 1842; and on 19th March, 1847, retired on the half-pay of the Royal Staff Corps, being subsequently commissioned lieut.-colonel on 20th June, 1854, and colonel on 26th October, 1858, (vide Army Lists). He came to Nova Scotia from Quebec and settled in Windsor, where he lived for a while, marrying Jean Gordon, daughter of Rev. Archibald Gray of St. Matthew's Church, Halifax. Their daughter became the wife of our late president, J. Matthew Jones. Col. Myers left Windsor and came to Halifax about 1856, living at 'Ashbourne,' Dutch Village, afterwards well-known as the residence of his son-in-law, Mr. Jones. The past generation had pleasant recollections of him as a fine gentleman. He died suddenly while preparing to leave his house to attend

church, and is buried at St. John's cemetery. The very sad death of his son in January, 1870. will be recalled by many. Col. Myers was one of the original members of the Institute, and afterwards served on its council. He was a most enthusiastic student of meteorology, kept a very careful record of the weather at Halifax, as Henry Poole was doing elsewhere in the province, and I think his papers in our Transactions are the earliest full and systematic ones published here, although Poole, and possibly Hensley of Windsor, were in the field before him. This led to his election as a fellow of the Royal Meteorological Society. He published in our journal, notes on the weather at Halifax for four years, from 1863 to 1866. His work was then taken up by Frederick Allison in 1867, and the Dominion meteorological service was ultimately established in 1871.

Thomas Belt, geologist and naturalist.—Born in England, 1832; died at Denver, Colorado, 1878. Made geological investigations in the Australian gold-diggings from 1852 to 1862; came to Nova Scotia as superintendent of the N. S. Gold Company's mines in 1862, and returned to England (Newcastle-on-Tyne) in 1863 or 1864; conducted the gold-mining operations of the Chontales company, Nicaragua, from 1868 to 1872. Elected a fellow of the Geological Society in 1866. He published works which chiefly relate to the glacial period (for which some of his observations were made in this province), and also his popular classic, 'The Naturalist in Nicaragua' (1874), a work which contains much information on protective mimicry, plant fertilization, sexual selection, etc., and written in a fine style. He was one of the original members of the Institute, was elected to the first and second council, and was a member until his death. He contributed four papers to the Transactions, his list of butterflies observed about Halifax, being the first such catalogue to be published. (See Dict. of Nat. Biog., iv., p. 204; also Trans N. S. I. N. S., v., p. 4.)

JOHN ROBERT WILLIS, conchologist.—Born at Philadelphia, U. S. A., 14th February, 1825, son of John and Elizabeth Willis, of Irish extraction; died at Halifax, 31st March, 1876. He came to Halifax when a child and was educated there at the National School of which in 1846 he became a teacher. In 1863 was appointed superintendent of an industrial school on its establishment at Halifax, and resigned from the National School. In 1865 he took an active part in the efforts to establish a Provincial Museum at Halifax and was a candidate for the position of curator, but in the same year became secretary of the Board of School Commissioners, Halifax, and in 1875 retired, being thereafter in poor circumstances. About 1850 he began to study our mollusca, thus becoming the first Nova Scotian conchologist, and in 1857 his first known list of our shells appeared in an obscure publication, supposed to have been 'The Church Record', followed by two other lists, all of which are very rare. He made a large and very fine collection of shells, both native and foreign, said to have consisted of over 8000 specimens,but the location of the local part is unknown,and the foreign portion is in ruins. Corresponded largely with noted conchologists of the time, and large numbers of his Nova Scotian specimens are in the great museums of the United States and elsewhere, and a small collection is in the museum of King's College, Windsor, but in a dilapidated state. In 1862 he was elected a corresponding member of the Liverpool (Eng.) Natural History and Microscopical Society, and in the next year a corresponding member of the Boston Society of Natural History. Though he possessed his weaknesses, yet he was a man who was much liked for his good qualities. He had been connected with the old N. S. Literary and Scientific Society of Halifax; and was one of the original members of the Institute of Natural Science, and was elected one of its first joint-secretaries, but seems not to have acted, and must have resigned the position before 4th May,

1863, as he then signed the only minutes he wrote, as secretary *pro tempore*, and was succeeded by W. Gossip. He finally withdrew from the society about 1869. The Transactions contain but one paper by him, on the occurrence of *Littorina littorea* on the coast of Nova Scotia (1863), and I fear that for some reason entire harmony could not have existed between him and the society. Vol. VII however contains a full account of his life, his writings, and a reprint of his rare list of Nova Scotian shells, a memorial to which I think he was justly entitled. (See Trans, vii., pp. 404-428.)

Henry How, D. C. L., chemist, mineralogist and botanist. —Born at London, Eng., 11th July 1828, (son of Thomas How, whose wife was a Molyneux, whose ancestors had served in the old fort at Annapolis, N. S.); died at Windsor, N. S., Sunday, 28th September, 1879. He attended a private school in Beaconsfield and then studied chemistry at the Royal College of Chemistry, obtaining therefrom a certificate of proficiency. Prof. Hoffman, of that college, recommended him as assistant to the late Rt. Hon. Lord Playfair, F. R. S., then professor of chemistry at the College for Civil Engineers at Putney. His first paper, an analytical one, was read before the Chemical Society of London, and published in its Journal in 1846. He held his assistant professorship at Putney until he was appointed analytical chemist to the British Admiralty Steam Coal Enquiry, and in 1848-49 were published, as a British blue-book, his 'Analyses of Coals of Great Britain' with reports by Sir H. De la Beche and Dr. Lyon Playfair. Then he became assistant to Prof. Thomas Anderson of Edinburgh University, whom he accompanied in 1852 to Glasgow on the latter's appointment as Regius Professor of Chemistry in the University there, and was there for two years.

He came to Nova Scotia in 1854, being appointed fellow and professor of chemistry and natural history at King's College, Windsor, and about 1876, also vice-president of the

University and librarian. He filled the chair with untiring zeal and the most distinguished ability until his death, a period of some twenty-four years. His first paper on a Nova Scotian subject (natro-boro-calcite in gypsum) appeared in 1857 and was rapidly followed by very many others. In 1861 he was employed by the Provincial Commissioners of the Industrial Exhibition to make a collection of the minerals of the province for the Nova Scotian court at the London exhibition of the next year. This collection was awarded two medals, one in the class of mining and one in that of educational works and appliances. He prepared a report on the minerals, which however was not then published, but it subsequently appeared as a series of articles, entitled 'Notes on the Economic Geology of Nova Scotia,' in our Transactions (1864-69), and with a similar title in the 'London, Edinburgh and Dublin Philosophical Magazine' (1866-76). He also prepared for the Provincial Commissioners a second collection of our minerals for the Dublin Exhibition of 1865, which was awarded a medal; and another (of 240 specimens to which were added 84 specimens from the late Dr. Webster's collection), for the Paris International Exhibition of 1867, for which honorable mention was awarded. The latter fine collection was purchased by our government and incorporated in the Provincial Museum in 1868. To accompany and illustrate this set, he prepared a 'Sketch of the Mineralogy of Nova Scotia as illustrated by the Specimens sent to the Paris Exhibition,' for the official catalogue (1867). This was so much appreciated that it was decided to have him prepare a further report on the subject. Thereupon he published, by authority of the government, his chief work, 'The Mineralogy of Nova Scotia' (Halifax, 1869), a book which is still much used and relied upon for its fullness and accuracy. He discovered and named several new minerals found in this province, for example, mordenite, cryptomorphite, silicoborocalcite (which was superseded by Dana's name Howlite, in honor of him), and

winkworthite. The total number of new minerals found by him was said to have been fourteen. He was also a good botanist and prepared an herbarium of Nova Scotian plants for the Paris exhibition of 1867, which is now in the Provincial Museum. 'Every one who had come in contact with Dr. How,' says the King's College Record (Oct. 1879), had been struck with his honesty of purpose, his great love of science, his varied literary taste. From the moment he landed in this country, fresh from the wonderful laboratories of Europe and glowing with enthusiasm for the prosecution of his favorite studies, he had lived a life of obscurity, almost of seculsion. A few there were, and only a few, who had come to appreciate his talent as an analyst, his great learning as a chemist, his industry in fields of original research.' I may add that the last sentence is true as regards this province alone, for abroad his great ability was recognized fully. I think I am right in saying that he was the first notable chemist we had; he was most likely the best analytical chemist we have had. He was a successful experimenter and his researches, I understand, resulted in the discovery of certain acids, etc. Billings named in his honor, *Phillipsia howi*, one of the last representatives of the trilobites, discovered by How at Kennetcook, N. S., (Can. Naturalist, viii., 209); and Dawson in the preface to his Acadian Geology, and Dana in that to his Mineralogy, acknowledge indebtedness to him for valuable contributions. Furthermore he was a fine German, French and Latin scholar.

He was an original member of our Institute and contributed to its Transactions 10 papers (14 if we count the separate parts of one of them), almost entirely on mineralogy and botany. Had he lived in Halifax, he would certainly have become a president of the society which he assisted so much by his labours otherwise. He was an honorary D. C. L. of King's College (1861), corresponding member of the New York Lyceum of Natural History and of the Natural History

Society of Montreal, etc. He possessed testimonials from some of the most distinguished chemists of England and France, and he had been heard to say, and no doubt rightly, that he could have become a fellow of the Royal Society because of his original research work, if he had had the money to waste on such an honour. How's principal papers and books, in general chemistry, analytical chemistry, mineralogy and botany, number over 44 items, and appeared in the Journal of the Chemical Society (London), Transactions of the Royal Society of Edinburgh, the Edinburgh New Philosophical Journal, Silliman's Journal, the London, Edinburgh and Dublin Philosophical Magazine, the Canadian Naturalist, Chemical News, our own Transactions, and elsewhere. (See King's College Record, Windsor, October, 1879, with list of 44 of his writings; introduction to his mineralogy of N. S.; also private sources.)

ANDREW DOWNS, C. M. Z. S., ornithologist.—Born in New Brunswick, New Jersey, 27th September, 1811, son of Robert and Elizabeth Downs, of Scotch parentage; died at Halifax ,26th August, 1892. Settled at Halifax in 1825 and engaged in the plumbing business, but became deeply interested in birds and other animals, and their preservation and propagation, to which he finally devoted all his attention. He remembered seeing Audubon at Halifax on 27th August, 1833, and afterwards corresponded with him and other notable naturalists. From about May 1844 to May 1846, he was assistant curator of the Halifax Mechanics' Institute; and from then till about May 1847, was its curator. In 1847 he established at Dutch Village, near Halifax, the first zoological garden in America, sixteen years before the Central Park collection at New York was opened. This soon became very popular and was visited by persons of note who came to Halifax. In 1864 he visited Europe with specimens, alive and mounted, which he presented to the Zoological Gardens at London. In 1867 he was proposed as superintendent of the

Central Park menagerie, New York, under a recommendation from Prof. S. F. Baird, and the next year went there to assume the position, but displeased by what he considered to be an over-abrupt reception, declined the appointment and returned to Halifax. He then started a new zoological garden near his earlier one, which he maintained for about three years. A couple of years before his death, although of venerable age, he built a museum annex to his house in Halifax where he was surrounded by a large collection of native birds. Ornithology was his chief study, and his knowledge of our local birds was extensive, and would have been much greater had he made a practice of keeping notes. He gave freely of his information to others, and delighted in encouraging in young people the outdoor study of nature. As an taxidermist he possessed rare skill, being the best workman of this kind we have ever had in Nova Scotia, and receiving bronze medals at the London exhibitions of 1851 and 1862 and the Dublin exhibition of 1865, and a silver one at Paris in 1867. His Paris exhibit was praised by Sir Wyville Thomson in the Illustrated London News. He mounted some 800 moose-heads, and specimens of his work were supplied to various European sovereigns, and large quantities went to various museums. He was an original member of this Institute, although not taking up his membership till a year later, and served on the council. In 1862 he was elected a corresponding member of the Zoological Society of London. Owing to his great lack of literary training, he wrote very little, but his store of self-acquired knowledge was disseminated verbally or by letters, and others profited by it. Had he possessed more education and scientific training, I have no doubt the native genius of the man would have caused him to make a more notable record among our naturalists. Three papers by him appeared in our Transactions—his only published work. His 'Land Birds of Nova Scotia' (Trans., I, 1865-66), was the first full list of the kind we have, with the exception of Lt. Blakis-

ton and Lt. Bland's shorter 'List of Birds of N. S.' (compiled by J. R. Willis) which appeared in the Smithsonian Report for 1858 (Wash., 1859, pp. 280-286), and which I suspect contained many of Downs's observations. (See sketch of his life by H. Piers, Trans, x., p. xii., with portrait; Chas. Hallock, 'First American Zoo', Nature, N. Y., vol. 1(1891?), pp, 130-131; Chas. Hallock, 'Andrew Downs, naturalist,' Forest and Stream, N. Y., vol. 53(1899), p. 184, with portrait, p. 182; Gen. Campbell Hardy, 'Reminiscences of a Nova Scotian Naturalist, Andrew Downs,' Trans. xii. p. xi.)

John Hunter Duvar.—Born 29th August, 1830, of Scottish-English parentage; died in Prince Edward Island, (?) January, 1899. Educated in Scotland. It is as a litterateur and poet that Duvar has left a name in Canada. He contributed many papers on history, literature and art to various periodicals. As a poet he displayed good song quality in his briefer lyrics, and in 1879 published 'The Enamoranda' and 'De Roberval,' a Canadian drama, in 1888. In the latter years of his life he resided in Prince Edward Island, and was connected with the Dominion Department of Fisheries. He was one of the original members of the Institute and was for a time a member of its council until he left Halifax for Prince Edward Island about 1868, and published a couple of papers in the first volume of Transactions, but had no standing as a scientist. (Biographical notes, 'Songs of the Great Dominion').

John Brookin Young.—Born at Halifax, about 1835, eldest son of George Rennie Young and grandson of John Young ('Agricola'); lost in the 'City of Boston' which left Halifax on 25 Jan. 1870. Was a civil engineer and practised in Halifax where he lived all his life. He was an original member of the Institute and was its assistant, or joint secretary, from December, 1862 to October, 1864, but contributed nothing to its Transactions, and withdrew from the society sometime before 1865.

Rev. John Mocket Cramp, D. D.—Born at St. Peter's, England, 25th, July, 1796, son of Rev. Thomas Cramp, pastor of St. Peter's Baptist Church; died at Wolfville, N. S., 6th December, 1881. Was ordained in 1818, and from that year to 1825 was pastor of Dean St. Baptist Church, Southward; from 1827 to 1842 co-pastor with his father at St. Peter's; and from 1842 to 1844 was pastor at Hastings. In 1844 he came to Canada as principal of the Montreal Baptist College, Montreal, holding that position until 1851 when he was appointed president of Acadia College, Wolfville, N. S. From 1853 to 1855 he was principal of the Theological Institute, Acadia College, and from the latter year until 1869 was again president of Acadia. He was one of our original members, but contributed nothing to its Transactions although retaining his interest in its welfare.

Colonel Francis Duncan, R. A., C. B., M. P., LL. D., D. C. L.—Born 4th April, 1836; died, 1888. Graduated M. A. from Marischal College, Aberdeen and commissioned lieutenant in Royal Artillery, 24th September, 1855; served at Halifax and in Canada, 1857 to 1862; commissioned captain in 1864 and major in 1874 Was instructor in gunnery, School of Gunnery, Shoeburyness, 1877 to 1882. Became lieutenant-colonel in 1881, and was employed with the Egyptian Army from January, 1883, to November, 1885, taking an active part in the Soudan Expedition of 1884-5, commanded the artillery of the Egyptian army and employed on lines of communication and as commandant of Wady Halfa. Was mentioned in despatches, became a colonel in June 1885, received the Egyptian medal with clasp and made C. B. (1885). Was conservative member of parliament for Holborn division of Finsbury, 1885-6. Received the degree of LL.D from Aberdeen, and D. C. L. from Durham. Duncan, who was stationed at Halifax from 1857 to 1862 with Hardy, was among the names of the original members of the Institute of Natural Science, and deserves mention here only

on that account, as he seems to have then gone to Canada and could not take an active part in its proceedings, and most likely never took up his membership. (See. Dict. of Nat. Biog., Suppl. vol. ii., p. 166).

Pierce Stevens Hamilton.—Born at Truro, N. S., 1826; died at Halifax, 22nd February, 1893. He matriculated at Acadia College, but did not graduate. Admitted an attorney in 1851 and a barrister in 1852, and practised at first at Truro, and afterwards at Halifax. Abandoned his profession to take up journalism, and edited the *Acadian Recorder* from 1853 to 1861. In 1863 was appointed the first Go d Commissioner of Nova Scotia and the next year his duties were extended and he became Chief Commissioner of Mines, holding office till about 1867. About 1871 he went to western Canada and re-entered journalism, but finally returned to Halifax where he died under somewhat distressing circumstances. He was elected a member of the Institute on 2nd March, 1863, served for a time in its council, and contributed three papers to its Transactions on geology and physical geography. He also published several pamphlets on other subjects. (See Morgan's Bibliotheca Canadensis; also Acadian Recorder, 22 Feb., 1893.)

William Chamberlain Silver.—Born at Preston, Halifax Co., Dec., 1814, son of William Nyan Silver, of Kentish extraction, who came to Nova Scotia in 1804; died at Halifax, 23rd February, 1903. Mr. Silver was a well known and philanthropic merchant of Halifax, the memory of whom is still fresh in our minds. While not at all an active worker in the field of science, he took an interest in it, and joined the Institute on 7th May, 1864. It is as a faithful officer of the society for the very long period of over thirty-five years, that he deserves notice here. He was elected its second treasurer, succeeding Capt. W. Lyttleton, on 9th October, 1867, and nominally retained the office (although in latter years deputing the work) till his death—the longest office term we

have had in the society. (See Acadian Recorder, Hfx., 24th February, 1903).

Rev. David Honeyman, D. C. L., F. G. S., F. R. S. C., geologist.—Born at Corbie Hill, Fifeshire, Scotland, in 1817; died at Halifax, 17th October, 1889. Educated at Dundee High School and the University of St. Andrews, where he devoted himself to the study of oriental languages and natural science. In 1836 he entered the United Secession Theological Hall, was licensed in 1841, and about 1846 came to Nova Scotia where he became professor of Hebrew in the Free Church College, Halifax, but resigned not long after. He subsequently took charge of the Presbyterian church at Antigonish, but as a preacher was not successful. All his spare time was given to the study of the geology of that district, the complicated formations of Arisaig having his special attention. After being a few years pastor at Antigonish, he resigned, although continuing to reside there until about 1868, and thereafter devoted himself to scientific work. He published his first paper, on the fossiliferous rocks of Arisaig, in the Transactions of the N. S. Literary and Scientific Society for 1859. He had charge of the Nova Scotian exhibits at the London International Exhibition of 1862, at the Dublin Exhibition of 1865, the Paris Exhibition of 1867, the Philadelphia Exhibition of 1876, and the London Fisheries Exhibition of 1883. For a short while in 1869 he was employed in Nova Scotia by the Geological Survey of Canada, for which he was fitted as a geologist, but had had no training as a topographer and draughtsman. J. R. Willis and he had, in 1865, presented a memorial to the government strongly advocating the establishment of a provincial museum, a matter which had come up four years previously, and the two memorialists became candidates for the position of curator. As a result of the agitation in various quarters, the Provincial Museum of Nova Scotia was founded about October, 1868, and Honeyman was placed in charge (at first, I believe, with-

out a salary), and he laboured at building up that institution until his sudden death in 1889. Honeyman joined the Institute of Natural Science on 3rd December, 1866, and in 1870 became a member of its council, and on 11th October, 1871, was elected honorary secretary (afterwards known as corresponding secretary), which position he held till his death, a period of eighteen years. He gave very much time and energy to the affairs of the society, which for a long period met in the museum, and succeeded Gossip as editor of the Transactions. His chief service to us, however, was the contribution to the Transactions of a very long series of papers, mostly on geological subjects, but latterly interspersed with some on marine zoology. Their number, no less than fifty-eight, makes him the most voluminous writer we have had. He also published a few papers elsewhere, and a small geological work called "Giants and Pigmies" (Halifax, 1887). He was a good geologist, probably the best the society has had among its ordinary members, although some of his conclusions came in for considerable criticism from certain quarters. His little tilts with Sir William Dawson will be recalled by our older members. It must be admitted, however, that his literary style lacked perspicuity and scientific precision and orderliness, which unfortunately has caused his reputation to suffer somewhat with those who only know him and his work by his writings. I have always felt that his writings do not do him the justice he deserves. His genial character we all remember well. He was a D. C. L. of King's College, Windsor, (1864), a fellow of the Geological Society of London (1862), an original fellow of the Royal Society of Canada (1882), a member of the Geological Society of France, honorary member of the Geologists' Association of London and of the Society of Science, Letters and Art (London), a corresponding member of the Society of Arts (London) and of the Horticultural Society (London), as well as an original member of the Geological Society of America, etc. He received the

Mantuan medal for scientific eminence, and various medals from the great exhibitions. (See Trans., vii., p. 313; obituary by MacGregor, Trans., vii., p. 320, with portrait.)

Frederick Allison, meteorologist.—Born at Halifax, 1835, son of Hon. Joseph Allison, (of north of Ireland descent); died at Halifax, 29th April, 1879. His family having moved to Windsor about 1845 or 1846, he entered King's College, in 1848, and received the degree of B. A. in 1851, and M. A. in 1865, later in life becoming one of the board of governors. He spent some years in the West Indies in a mercantile capacity, but afterwards returned to Halifax and later entered into the life insurance business and also became agent for the Collins estate. He married a daughter of Harry King of Windsor. In 1848 he began making observations on temperature at Windsor and on the death of Col. W. J. Myers, a private observor, in 1867, Allison took up the recording and publishing in the Institute's Transactions of careful meteorological observations made at his residence, South Park Street, Halifax, work which had previously been done by Myers. Later he joined with G. T. Kingston of the Toronto observatory, in urging upon the people and the government the need of a general meteorological service for the Dominion. This led to the establishment of such a department in 1871, and he was then appointed the first chief-meteorological agent for Nova Scotia, a position which he filled with ability and enthusiasm until his death, taking an interest in the progress of the service as he had in its inception. He was succeeded by his cousin and assistant, Augustus Allison. F. Allison joined the Institute in Feb., 1869, was Second Vice-President from October, 1874, to October 1878, and First Vice-President from then till his death. He was the chief contributor of meteorological papers to our Transactions (11 articles), and his carefully prepared annual summaries of our weather were looked forward to with interest. It is much to be regretted that these papers were not continued in our publications by

his successors. (See Trans., v., p. 5; Ann. Report. Meteor. Service of Canada, for 1879, p. v.)

AUGUSTUS ALLISON, meteorologist.—Born at Halifax, 19 April, 1837, son of Jonathan Crane Allison of the firm of Fairbanks and Allison; died at Halifax, 11th January, 1904. He had been assistant to his second cousin, Frederick Allison, and on the latter's death in April, 1879, continued the meteorological observations until he was regularly appointed chief meteorologcal agent for Nova Scotia in August following, retaining that position till his death when he was succeeded by F. P. Ronnan. In business Mr. Allison was connected with the Confederation Life Association. He married Miss Cevilla Hill. He joined the Institute on the same date as his cousin, 15th February, 1869, but contributed but one paper to its Transactions (Meteorological Register for 1880), and lacked the enthusiasm in the work which characterized his relative.

HENRY YOULE HIND, M. A., D. C. L., F. R. G. S., geologist and explorer.—Born at Nottingham, England, 1st June, 1823; died at Windsor, N. S., 9th August, 1908. Dr. Hind was a geologist with a large and well-deserved reputation, but as his connection with this Institute was but very slight, the present notice will be brief. He was educated at Leipsic and Cambridge, came to Canada in 1846, and two years later became a master in the Provincial Normal School, Toronto, and subsequently professor of chemistry and geology in Trinity College in the same place until 1864. In 1857 he became geologist to the first Red River expedition, and next year director of the Assiniboine and Saskatchewan exploring expedition, and in 1861 made explorations in the regions about Labrador, while in 1864 he made a preliminary geological survey of New Brunswick. In 1866 he took up his residence in Windsor, where he died. His reports on the gold districts of Nova Scotia are well-known and valuable, and he contributed to the publications of the Royal Geographical Society, the Geological Society, Society of Arts, and many

other scientific journals; his writings altogether being most voluminous.* He was also a keen student of history, and in other respects a remarkable man. He joined the Institute in February, 1869, and read three geological papers before it, only one of which was published. The non-publication of his paper of January 1870, 'On the Laurentian Rocks', seems to have been about contemporary with his early withdrawal from the society, and may have had something to do with it. His third paper, presented in March, 1904, was withdrawn. (See Morgan's Canadian Men and Women of the Time, 1898).

Rev. George Patterson, D. D., LL. D., F. R. S. C., archæologist.—Born at Pictou, N. S., 30th April, 1824, son of Abram Patterson; died at New Glasgow, 26th October, 1897. Was educated at Pictou Academy, Dalhousie College, and the United Presbyterian Theological Hall, Edinburgh, being ordained in 1849. Labored for twenty-seven years as a minister at Greenhill, Pictou Co., till 1879, when he went to New Glasgow. In 1843, at age of nineteen, he is said to have established and edited the 'Eastern Chronicle' newspaper, and in 1850 he began to publish and edit the 'Missionary Register of the Presbyterian Church of N. S.,' afterwards superseded by the 'Missionary Record'. Was chiefly notable as a historian and theological biographer, being an industrious and painstaking compiler of facts, and wrote a well-known 'History of Pictou County' (1877), 'Memoir of Rev. Dr. MacGregor' (1859), 'Life of Dr. Keir' (——), 'Memorials of Johnston and Mattheson' (1864), and 'Life of Rev. John Geddie' (1882). His scientific work was subsidiary to that relating to history. A full list of his papers down to 1894, will be found in the Transactions of the Royal Society of Canada for that year. He was not elected a member of this Institute until 12th March, 1878, and published in its Transactions three papers, one describing the collection of Indian stone implements which he presented to Dalhousie College, one of a geological character, and the last descriptive of the

*Hind's "Effect of Fishery Clauses of Treaty of Washington on Fisheries and Fishermen of B. N. A.", prepared for the Fishery Commission, Halifax, 1877, contains much compiled information regarding our fisheries.

Newfoundland dialect. Princeton conferred on him the degree of D. D. (about 1870), and Dalhousie that of L L. D. (1896). In 1889 he was elected a fellow of the Royal Society of Canada. (See obituary by E. Gilpin, Trans. ix., p. xcv., with portrait; Morgan's Canadian Men and Women of the Time, 1898).

John James Fox.—Born at Salisbury, England, 1818; died at Montreal, September, 1899. He studied medicine, but preferring a sea-faring life, spent many adventurous years in Egypt, Greece, the West Indies and South America. In 1852 he was appointed by the British Government comptroller of customs and navigation laws at the Magdalen Islands, a position which he held for thirty years, and became familiarly known as the 'governor' of those islands. For services to ship-wrecked mariners, the United States President presented to him a watch valued at $1,000. His great knowledge of the fisheries made him a valuable witness before the Halifax fisheries commission of 1877. After retiring about 1882 he moved to Halifax, where he resided for some years, and finally went to Montreal in about 1890. He was characterized by modesty, bravery and humanity. An anecdote is told of how he amputated a man's leg, when proper surgical aid was absent. He joined the Institute in May, 1882, was for six years a member of its council (October, 1884 to October 1890), seldom missed a meeting, and continued his membership till his death. One paper from his pen appeared in the Transactions, dealing with the currents of the Gulf of St. Lawrence and their danger to navigation (vol.vi., p. 302.) (See obituaries, Trans., x., p. xxxvi., [A. McKay], and in Halifax Herald, 15th September, 1899).

Arthur Peters Silver, sportsman-naturalist.—Born at Halifax, 9th January, 1851, son of Wm. C. Silver (q. v.); died at same place, 14th February, 1908. Was educated at the Halifax Grammar School, Dalhousie College, and King's

College, Windsor, but did not, I believe, proceed to a degree. Became a partner in his father's dry-goods business in 1872, but retired in 1898, since when he devoted himself to farming at 'Riverbank', Preston, near Dartmouth, to sports, and literary pursuits. Was a keen lover of the rod and gun and became vice-president of the Game and Inland Fisheries Protection Society of N. S. Contributed many sporting sketches to 'The Badmington', 'Country Life', 'The Empire Review', 'World Wide', 'Chambers's Journal', etc. Also author of an interesting work entitled 'Farm, Cottage, Camp and Canoe in Maritime Canada' (1908) which appeared about the time of his death, and which should be read along with Hardy's 'Forest Life in Acadie'. He took a great interest in all that related to wild animal life, and was elected a member of the Institute in December, 1887, but retired about 1902. He published but one paper in our Transactions, a list of Nova Scotian Butterflies, a subject to which he had given considerable attention. (See Morgan's 'Canadian Men and Women of the Time,' 1912).

Hugh Fletcher, B. A., geologist,—Born at London, England, 9th December, 1848, son of Hugh Rose Fletcher, a mining engineer of Scotch birth; died at Lower Cove, N. S., 23rd September, 1909. About 1858 he came to Montreal, a year after his father. In 1860 the family moved to the Bruce Mines in Lake Huron, and the fall of 1862, to Toronto. Educated at Toronto University, where he was a silver medallist in natural science, and otherwise distinguished himself. Became connected with the gold mines at Tangier, where his father was in charge. Joined the Geological Survey of Canada on 1st September, 1872, and took up work in the Sydney coal-field, and up to the time of his death, was employed in mapping and writing reports on the geology of Nova Scotia, having worked out in detail the structure of the Island of Cape Breton, and the counties of Guysborough, Antigonish, Pictou, Cumberland, Colchester, Hants, Kings and Annapolis.

He was the leading authority on our coal and iron deposits, and in fact knew more about our geology and mineral resource (excepting probably gold) than possibly any other man. His genial, kindly and extremely modest character was marked by every one who came in contact with him. His many maps and reports as well as other papers are a monument to his energy and display his great knowledge of a subject of which he had made a life-long study. He passed away in the midst of active work. He was elected a corresponding member of this Institute on 3rd March, 1891, and published three valuable papers in its later Transactions. (See The Nova Scotian, Mining Number, October, 1903, p. 59, with portrait; Journal of Mining Soc. of N. S.. vol. xv., 1910, p. 131, with excellent portrait.)

The curious may be interested in considering the foregoing list in the light of origin, as indicated by birth-place:

	Presidents.	Other Members.	Total.
Nova Scotian..............	3	8	11
English....................	1	5	6
Scotch.....................	1	2	3
Canadian and Newfoundland..	1	2	3
United States of America.... .	1*	2†	3‡
Welsh......................	1	0	1
Irish......................	0	0	0
Total................	8	19	27

* English parentage. † 1 Irish parentage. ‡ 1 Scotch parentage.

LIST OF OFFICERS, 1862 TO 1912.

Presidents.

Names.	Term of Office. From	To	No. of years.
1. Hon. Philip Carteret Hill, D. C. L., Q. C	31 Dec. 1862	26 Oct. 1863	1
2. John Matthew Jones, F. L. S., F. R. S. C	26 Oct. 1863	8 Oct. 1873	10
3. John Bernard Gilpin, M. A., M. D., M. R. C. S	8 Oct. 1873	9 Oct. 1878	5
4. William Gossip	9 Oct. 1878	13 Oct. 1880	2
5 John Somers, M. D	13 Oct. 1880	10 Oct. 1883	3
6. Robert Morrow	10 Oct. 1883	5 Aug. 1885	2
7. John Somers, M. D	21 Oct. 1885	10 Oct. 1888	3
8. Prof. James Gordon MacGregor, D. SC., F. R. S., F. R. S. C	10 Oct. 1888	9 Nov. 1891	3
9 Martin Murphy, C. E., D. SC., I. S. O	9 Nov. 1891	8 Nov. 1893	2
10. Prof. George Lawson, PH. D., F. I. C., F. R. S. C	8 Nov. 1893	10 Nov. 1895	2
11. Edwin Gilpin, Jr., LL., D., D. SC., F. G. S., F. R. S. C., I. S. O	18 Nov. 1895	8 Nov. 1897	2
12. Alexander McKay, M. A	8 Nov. 1897	20 Nov. 1899	2
13. Alexander Howard MacKay, B. SC., LL. D., F. R. S. C.	20 Nov. 1899	24 Nov. 1902	3
14. Henry Skeffington Poole, D. SC., A. R. S. M., F. G. S., F. R. S. C	24 Nov. 1902	18 Oct. 1905	3
15. Francis William Whitney Doane, C. E	18 Oct. 1905	11 Nov. 1907	2
16. Prof. Ebenezer MacKay, PH. D	11 Nov. 1907	14 Nov. 1910	3
17. Watson Lenley Bishop	14 Nov. 1910	11 Nov. 1912	2
18. Donald MacEachern Fergusson, F. C. S	11 Nov. 1912		

NOTE—Since 1879 the presidents of the Institute have been *ex-officio* Fellows of the Royal Microscopical Society.

First Vice-Presidents.

Names.	Term of Office. From	To	No. of Years.
1. John Matthew Jones, F. L. S., F. R. S. C	31 Dec. 1862	26 Oct. 1863	1
2. John Bernard Gilpin, M. D	26 Oct. 1863	12 Oct. 1864	1
3. Capt. (now Maj. Gen.) Campbell Hardy, R. A	12 Oct. 1864	9 Oct. 1867	3
4. John Bernard Gilpin, M. D	9 Oct. 1867	12 Oct. 1870	3
5. George Lawson, PH. D., LL. D	12 Oct. 1870	9 Oct. 1872	2
6. John Bernard Gilpin, M. D	9 Oct. 1872	8 Oct. 1873	1
7. John Matthew Jones, F. L. S., F. R. S. C	8 Oct. 1873	14 Oct. 1874	1
8. William Gossip	14 Oct. 1874	9 Oct. 1878	4
9. Frederick Allison	9 Oct. 1878	29 Aprl. 1879	½
10. John Somers, M. D	11 Oct. 1879	13 Oct. 1880	1
11. Robert Morrow	13 Oct. 1880	10 Oct. 1883	3
12. John Somers, M. D	10 Oct. 1883	21 Oct. 1885	2
13. William Gossip	21 Oct. 1885	12 Oct. 1887	2
14. Prof. James Gordon MacGregor, D. SC., F. R. S	12 Oct. 1887	10 Oct. 1888	1
15. Martin Murphy, C. E., D. SC., I. S. O	10 Oct. 1888	9 Nov. 1891	3
16. Henry Skeffington Poole, D. SC., F. G. S	9 Nov. 1891	21 Nov. 1892	1
17. Prof. George Lawson, PH. D., LL. D	21 Nov. 1892	8 Nov. 1893	1
18. Alexander Howard MacKay, LL. D., F. R. S. C	8 Nov. 1893	12 Nov. 1894	1
19. Alexander McKay, M. A	12 Nov. 1894	8 Nov. 1897	3
20. Alexander Howard MacKay, LL. D., F. R. S. C	8 Nov. 1897	20 Nov. 1899	2
21. Francis William Whitney Doane, C. E	20 Nov. 1899	18 Oct. 1905	6
22. Prof. Ebenezer MacKay, PH. D	18 Oct. 1905	11 Nov. 1907	2
23. Prof. Joseph Edmond Woodman, D. SC	11 Nov. 1907	8 Nov. 1909	2
24. Watson Lenley Bishop	8 Nov. 1909	12 Dec. 1910	1
25. Donald MacEachern Fergusson, F. C. S	12 Dec. 1910	13 Nov. 1911	1
26. Alexander Howard MacKay, LL. D., F. R. S. C	13 Nov. 1911	8 Oct. 1913	2
27. Arthur Stanley MacKenzie, PH. D., F. R. S. C	8 Oct. 1913	21 Oct. 1914	1

Second Vice-Presidents.

	Name	*Term of Office.* *From*	*To*	*No. of Years.*
1.	Robert Grant Haliburton, F. S. A.	31 Dec. 1862	26 Oct. 1863	1
2.	Capt. Campbell Hardy, R. A.	26 Oct. 1863	12 Oct. 1864	1
3.	John Bernard Gilpin, M. D.	12 Oct. 1864	9 Oct. 1867	3
4.	James Ratchford DeWolf	9 Oct. 1867	8 Nov. 1869	2
5.	Prof. George Lawson, PH. D., LL. D.	8 Nov. 1869	12 Oct. 1870	1
6.	John Bernard Gilpin, M. D.	12 Oct. 1870	9 Oct. 1872	2
7.	Prof. George Lawson, PH. D , LL. D.	9 Oct. 1872	8 Oct. 1873	1
8.	James Ratchford DeWolf, M. D.	8 Oct. 1873	14 Oct. 1874	1
9.	Frederick Allison	14 Oct. 1874	9 Oct. 1878	4
10.	Prof. George Lawson, PH. D., LL. D.	9 Oct. 1878	12 Oct. 1881	3
11.	Augustus Allison	12 Oct. 1881	11 Oct. 1882	1
12.	Martin Murphy	11 Oct. 1882	10 Oct. 1883	1
13.	William Gossip	10 Oct. 1883	8 Oct. 1884	1
14.	Prof. James Gordon MacGregor, D. SC.	8 Oct. 1884	12 Oct. 1887	3
15.	Alexander Howard MacKay, B. A.	12 Oct. 1887	8 Oct. 1890	3
16.	John Somers, M. D.	8 Oct. 1890	9 Nov. 1891	1
17.	Prof. George Lawson	9 Nov. 1891	21 Nov. 1892	1
18.	Henry Skeffington Poole, F. G. S.	21 Nov. 1892	8 Nov. 1893	1
19.	John Somers, M. D.	8 Nov. 1893	12 Nov. 1894	1
20.	Edwin Gilpin, Jr. LL. D.	12 Nov. 1894	18 Nov. 1895	1
21.	Alexander Howard MacKay, LL. D.	18 Nov. 1895	8 Nov. 1897	2
22.	Francis William Whitney Doane	8 Nov. 1897	20 Nov. 1899	2
23.	Henry Skeffington Poole, A. R. S. M., F. G. S.	20 Nov. 1899	24 Nov. 1902	3
24.	Prof. Ebenezer MacKay, PH. D.	24 Nov. 1902	18 Oct. 1905	3
25.	Prof. Joseph Edmond Woodman, D. SC.	18 Oct. 1905	11 Nov. 1907	2
26.	Watson Lenley Bishop	11 Nov. 1907	8 Nov. 1909	2
27.	Prof. Arthur Stanley MacKenzie, PH. D.	8 Nov. 1909	12 Dec. 1910	1
28.	Philip Albert Freeman	12 Dec. 1910	13 Nov. 1911	1
29.	Donald MacEachern Fergusson	13 Nov. 1911	11 Nov. 1912	1
30.	Prof. Howard Logan Bronson, PH. D.	11 Nov. 1912	8 Oct. 1913	1

Note—First and Second Vice-Presidents first so called in Oct., 1881.

Treasurers.

	Name	*Term of Office* *From*	*To*	*No. of Years*
1.	Captain Westcote Whitchurch Lyttleton	31 Dec. 1862	9 Oct. 1867	5
	John Matthew Jones, acting Treasurer.	Sum. 1866	9 Oct. 1867	
2.	William Chamberlain Silver	9 Oct. 1867	23 Feb. 1903	35 4/12
3.	William McKerron (Appointed by Council)	9 Mar 1903	12 Nov. 1906	3 8/12
4.	Joseph Baker McCarthy, B. A., M. SC.	12 Nov. 1906	11 Nov. 1907	1
5.	Maynard Bowman, B. A.	11 Nov. 1907		

Corresponding Secretaries.

	Name	*Term of Office* *From*	*To*	*No. of Years.*
1.	John Robert Willis	31 Dec. 1862	26 Oct. 1863	1
2.	William Gossip	26 Oct. 1863	11 Oct. 1871	8
3.	Rev. David Honeyman, D. C. L., F. G. S., F. R. S. C.	11 Oct. 1871	17 Oct. 1889	18
4.	Alexander Howard MacKay, LL. D., F. R. S. C.	8 Oct. 1890	8 Nov. 1892	2
5.	Prof. James Gordon MacGregor, D. SC., F. R. S.	8 Nov. 1892	9 Dec. 1901	9
6.	Prof. Ebenezer MacKay, PH. D.	9 Dec. 1901	24 Nov. 1902	1
7.	Alexander Howard MacKay, LL. D., F. R. S. C.	24 Nov. 1902	13 Nov. 1911	9
8.	Prof. Ebenezer MacKay, PH. D.	13 Nov. 1911		

Note—The official terms, Corresponding and Recording Secretaries, were first used in the By-Laws passed in Oct. 1884. Prior to that, these officers were called the First and Second Secretaries. Willis seems not to have acted, for the only minutes that are found of his, are those of 4 May, 1863, which are signed as "secretary *pro tem*".

Recording Secretaries.

Names	*Term of Office* *From*	*To*	*No. of Years.*
1. John Brookin Young	31 Dec. 1862	12 Oct. 1864	2
2. Alexander S. Finnie	12 Oct. 1864	9 Oct. 1865	1
(No Second Secretary)	9 Oct. 1865	9 Oct. 1872	8
3. Angus Ross	9 Oct. 1872	13 Oct. 1875	3
4. John Thomas Mellish, M. A., D. C. L.	13 Oct. 1875	12 Oct. 1881	6
5. Alexander MacKay, M. A.	12 Oct. 1881	21 Oct. 1885	4
6. Simon Donald Macdonald, D. D. S.	21 Oct. 1885	13 Oct. 1886	1
7. Alexander McKay, M. A.	13 Oct. 1886	12 Nov. 1894	8
8. Harry Piers	12 Nov. 1894		

Note—The term Recording Secretary was first used in the By-Laws passed in Oct. 1884. Prior to that, this officer was called the Second Secretary. From Oct. 1865 to Oct. 1872, the duties of the Second Secretary were performed evidently by the First Secretary.

Librarians.

Name	*Term of Office.* *From*	*To*	*No. of Years.*
1. Adoniram Judson Denton	21 Oct. 1885	9 Oct. 1889	4
Harry Piers, Asst. Librarian	2 Nov. 1888	Jan. 1890	
2. Maynard Bowman, B. A.	9 Oct. 1889	24 Nov. 1902	13
3. Harry Piers	24 Nov. 1902		

Note—A "Curator of the Museum and Library" was first constituted by the By-Law adopted in Oct. 1885.

TRANSACTIONS

OF THE

Nova Scotian Institute of Science.

SESSION OF 1912-1913.

On the Electrical Resistance of Acetic Acid in the Solid and Liquid Phases.—By J. H. L. Johnstone, B. Sc., Dalhousie University, Halifax, N. S.*

Read, March 9, 1914.

In a previous paper[1] the writer published some results on the electrical resistance of ice, showing how it varied with the temperature. Its temperature-coefficient was found to be unexpectedly large and a further investigation of this point was thought desirable.

As it had been difficult to obtain satisfactory regulation of temperature below 0° C, it was decided to choose for the present investigation some substance with a melting-point so high, that with the substance in the solid state, the temperature could be regulated in a thermostat. Acetic acid appeared to fulfil these conditions; and it can be easily obtained in a comparatively pure state.

The method of measurement used in the previous investigation was inconvenient. It was also felt to be unsatisfactory as it was a direct current method and so introduced the danger of polarization effects. It seemed desirable therefore to obtain some alternating current method.

* Contributions from the Science Laboratories of Dalhousie University [Physics].
1 Trans. N. S. I. S. Vol., XIII, 2, pp. 126-144.

THE OBJECTS OF THIS WORK WERE:—

1. To determine a satisfactory method for the measurement of large electrolytic resistances.

2. To measure the electrical resistance of acetic acid in the solid and liquid phases at different temperatures and to find the causes of the variations which occur.

3. To determine the effect of small quantities of water on the resistance.

In the measurement of electrolytic resistances the effects of the electro-motive force of polarization are in general quite marked. This polarizing effect consists of two parts; one of which is a function of the current, $f(i)$, and is in fact, a variable resistance, increasing with time due to the deposition of gas on the electrodes. The other part, e, is a true polarization e. m. f. which is independent of the value of the current passing thru the electrolytic cell. It seldom amounts to more than 1 or 2 volts. Any alternating current method should practically eliminate both of these effects.

Using the well known method of Kohlrausch, resistances greater than 10^5 ohms, cannot be measured with any great accuracy. For satisfactory measurements of resistances ranging between 10^4 and 10^8 ohms another alternating current "bridge" method is suitable. In this method the telephone or galvanometer of the Kohlrausch apparatus is replaced by an electrometer and two of the resistances by capacities.

To measure resistances greater than 10^8 ohms, a direct current method may be used. The $f(i)$ term of the polarization effect will be very small as compared with the total resistance because the current flowing thru the cell will be minute, and furthermore as the applied e. m. f. is large the "e" term will be a small fraction of the total e. m. f. Using a sensitive galvanometer, connected as in figure 1, resistances ranging from 10^8 to 10^{10} ohms may be conveniently measured.

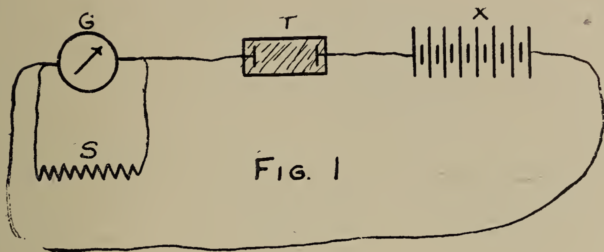

FIG. 1

For greater values of resistance than 10^{10} ohms, the electrometer may be substituted for the galvanometer and the apparatus connected as in figure 2.

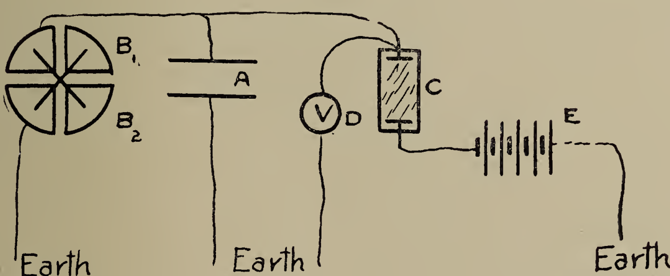

Fig 2

The A. C. Bridge method[1] referred to, was used considerably in this work. It consists of a network of two resistances and two condensers connected with a source of alternating current, (110V), as shown in figure 3. The electrometer was of the *Dolezalek* type but was fitted with an aluminium needle.

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1 Journal de Physique ; Series 5, III, Jan. '13.

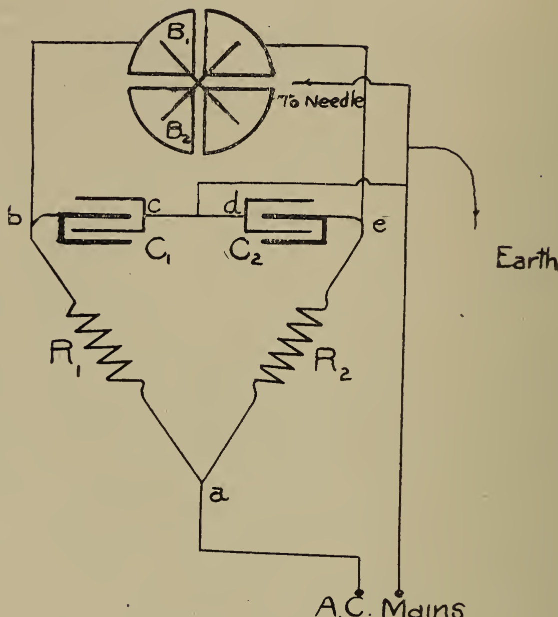

Fig 3

In fig. 3:—

B_1 and B_2 are two quadrants of the electrometer.

C_1 and C_2 are two capacities.

R_1 $\equiv$ an adjustable known resistance.

R_2 $\equiv$ the unknown resistance.

A. C. $\equiv$ terminals of A. C. circuit.

Applying Kirchoff's second law to the circuit.

$$I_1 R_1 \operatorname{Sin.} \omega t - \frac{I_1}{\omega C_1} \operatorname{Cos.} \omega t$$

$$= I_2 R_2 \operatorname{Sin.} (\omega t + \Phi) - \frac{I_2}{\omega C_2} (\operatorname{Cos.} \omega t + \Phi)$$

where I_1 is the maximum current flowing in branch *ac*.

I_2 " " " " " *ad*.

At the instant t, the difference in potential between the two pairs of quadrants is:

$$\frac{I_1}{\omega C_1} \text{Cos. } \omega t - \frac{I_2}{\omega C_2} \text{Cos. } (\omega t + \Phi).$$

If $\Phi = 0$ and if the above potential difference be zero, then there will be no deflection of the electrometer needle. Then:

$$\frac{I_1}{I_2} = \frac{C_1}{C_2}$$

$$\text{that is, } C_1 R_1 = C_2 R_2$$

which is the condition for no deflection. Hence if C_1, R_1 and C_2 be so chosen that with a given R_2, no deflection of the electrometer results, it is possible from the above equation to obtain the value of R_2. It is well to remark, that the most sensitive conditions for a balance exist when the reactances of condensers C_1 and C_2 are respectively equal to the resistances R_1 and R_2. In practice if the ratios $\frac{C_1}{R_1}$ and $\frac{C_2}{R_2}$ are each between 5 and $\frac{1}{5}$ comparatively good working conditions exist. This method is given in some detail, as it may be set up with ease and it will give very satisfactory results. Furthermore, it does not involve any knowledge regarding the absolute value of the capacities. It is the writer's belief that it deserves more general attention than it has hitherto received.

A standard $\frac{1}{3}$ M. F. condenser, manufactured by Leeds and Northrup, was used for capacity C_1.

The reactance of this condenser is 8000, approx., for a 60 cycle E. M. F. Four adjustable resistance boxes, manufactured by the same firm and having a combined resistance of 40,000 ohms were used for R_1. The values of R_2, which were measured by this method, ranged from 10^5 to 10^8 ohms and as considerable accuracy was desirable, it was necessary to manufacture three capacities having approximate reactance values of 10^6, 10^7 and 10^8 respectively. Two mica condensers

and a cylindrical condenser were made and their capacities were determined as follows:

If C_1, R_1 and R_2 be known, C_2 may be accurately measured, provided the condition for sensitivity be adhered to. A known resistance as great as 10^6 ohms was necessary for the calibration of the smallest capacity. A subdivided megohm was not obtainable, so three *Hittorf*[1] resistances were constructed. This type of resistance is non-polarizable and is made by filling a glass tube, fitted with Cadmium electrodes, with a 10% solution of cadmium iodide in amyl alcohol. The tube was then sealed off and placed in a larger test-tube filled with oil. Leads were then soldered to the electrodes and passed thru a cork, which closed the tube. (see figure 4).

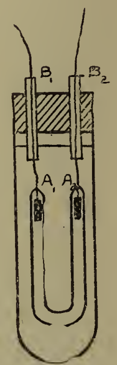

Fig. 4

The $\frac{1}{3}$ M. F. condenser was used as capacity C_1 in the network, thru-out the work.

I Making $C_2 \equiv .05$ M. F. of a "L and N" subdivided condenser,
and $R_1 \equiv 3000$ ohms,
R_2 was adjusted for a balance
and C_2 was obtained in terms of C_1.

II Making $C_2 \equiv .05$ M. F.
and $R_2 \equiv$ No. 1 resistance,
then R_1 was adjusted for a balance,
and No. I resistance was obtained.

III Making $C_2 \equiv$ Mica condenser No. I,
and $R_2 \equiv$ No. I resistance,
then R_1 was adjusted,
and No. I capacity was obtained.

IV Making $C_2 \equiv$ No. I condenser,
No. 2 resistance was determined in a similar way.

V Making $C_2 \equiv$ No. I condenser,
No. 2 capacity was measured.

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[1] Stewart and Gee, Pract. Physics, Vol. II, pp. 494.

VI Making $C_2 \equiv$ No. 2 condenser,
No. 3 resistance was measured.
VII Making $C_2 \equiv$ No. 3 condenser,
No. 3 condenser was measured.

Table I gives the values obtained for the different condensers and resistances. The above series of measurements were made every few days and it was found that the capacities remained remarkably constant, never showing variations greater than 1%.

To find if this method was reliable, the resistances were measured by a direct current method, (see fig. 1), and a very good agreement was found to exist in the two methods. These measurements were made when the tubes had remained in a thermostat for at least 15 minutes. The thremostat consisted of an inner and outer vessel. The outer was constructed so that cold water could be used to circulate about the inside vessel. A heating coil was placed in the latter and using electromagnetic regulation, temperatures ranging from 10 degrees above room temp., to 10 degrees below could be maintained to the tenth part of a degree.

TABLE No. 1.

C_1	R_1	C_2	R_2	Quantity Measured.
⅓	3000	.05 M.F.	20494	.05 M. F. = .0487 M. F.
⅓	26440	.0487 M.F.	R No. 1	Res. No. 1 = 1.81×10^5 ohms
⅓	4225	C. No. 1	No. 1	Cond. No. 1 = .00783 M. F.
⅓	16970	No. 1	No. 2	Res. No. 2 = 7.22×10^5
⅓	3170	No. 2	No. 2	Cond. No. 2 = .00146
⅓	36220	No. 2	No. 3	Res. No. 3 @ 9° C. = 8.27×10^6
⅓	5930	No. 3	No. 3	Cond. No. 3 = .000238

Bakers' acetic acid, (99.55% guaranteed), was used. To eliminate water the acid was fractionally frozen and the mother liquor was then poured off. The resistance of a sample was measured after each separation and it was found

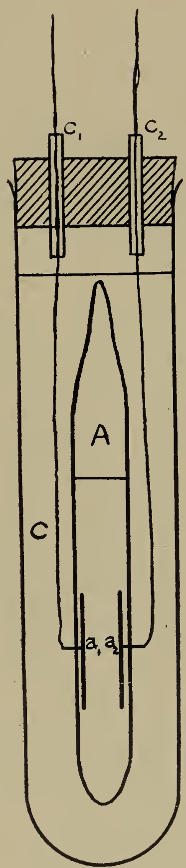

Fig. 5

that the specific resistance increased greatly after each freezing. The greatest number of freezings attempted in any one case was five. With more freezings, a purer sample could, no doubt, be obtained. However there is a limit to the purity obtainable in this manner as you can't prevent the absorption of moisture from the air: and there is also some dissociation. It was thought that the traces of water might be eliminated by adding acetic anhydride (Kahlbaum's C. P.) to the acid. This was tried but it was found that the specific conductivity of the anhydride was greater than that of the acid. Traces of *HCl.* were afterwards found in the anhydride, which would account for its conductivity.

The resistance vessel, A, (see figure 5), was blown from glass tubing of 0 .7 cm. bore and mane about 12cm. long Into the tube were sealed two platinum electrodes, a_1 and a_2, each of which had an area of about 2 sq. cm. and a chromicsulphuric acid cleaning solution was used. *NaOH* was then used and finally alcohol to remove grease etc. After washing many times with distilled water, the vessel was dried carefully. To ensure the removal of as much moisture as *possible from the glass,* the tube was connected to a mercury pump and heated to about 160° C in an oil bath for several hours. The pump was exhausted at intervals over a period of two days.

The "cell constant" was determined by measuring the resistance of a $\frac{1}{50}$ N. solution of *Kcl* on a *Kohlrausch bridge*[1] The tube was then sealed off and suspended in a test tube filled with oil, which was placed in the thermostat. On account of capacity effects it is essential that the thermostat be well earthed.

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[1] Kohlrausch, F., Physico. Chem. Measurements.

Measurements of the resistance of sample I were made at different temperatures ranging from —7°C. to the melting point. It was found possible to supercool to temperatures as low as 0°C with comparative ease, so measurements were made in the liquid phase at temperatures ranging from 25°C to 0°C.

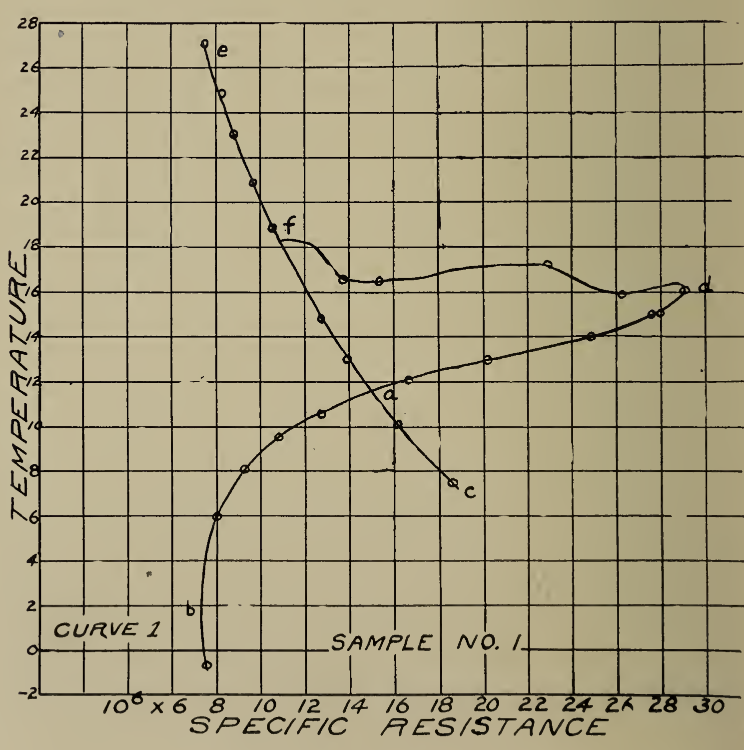
TABLE 2.

Sample 1. ≈ Cell Constant 0.166 ≈ M. P. 15.9° C.

TEMP.	STATE.	SP. RESISTANCE.
–.7°C.	Solid	7.48×10^{6}
+.6.0	"	7.95×10^{6}
8.0	"	9.25×10^{6}
9.5	"	1.10×10^{7}
10.5	"	1.27×10^{7}
12.0	"	1.66×10^{7}
12.9	"	2.01×10^{7}
14.0	"	2.48×10^{7}
15.	"	2.76×10^{7}
15.0	"	2.79×10^{7}
15.9	"	2.95×10^{7}
16.0	Liquefying	2.91×10^{7}
15.9	"	2.62×10^{7}
17.2	"	2.29×10^{7}
16.5	"	1.53×10^{7}
16.5	"	1.37×10^{7}
18.0	"	1.23×10^{7}
27.0	Liquid	7.48×10^{6}
24.9	"	8.24×10^{6}
23.	"	8.83×10^{6}
20.9	"	9.72×10^{6}
18.9	"	1.05×10^{7}
14.8	"	1.27×10^{7}
13.0	"	1.39×10^{7}
10.0	"	1.61×10^{7}
7.3	"	1.85×10^{7}
–80°C.	Solid	1.02×10^{13}

In table 2 are given values of the specific resistance for sample I, in the liquid and solid phases at temperatures ranging from 27°C to —7°C. Curve 1 shows how the specific resistance in each phase varies with the temperature. Starting at the point, *c*, on curve 1, the resistance at first decreases very slowly with rising temperature, then it begins to in-

crease slowly and then with great rapidity until the temperature has risen to the melting point, *d*. Liquefaction then begins and the resistance decreases very irregularly until finally the liquid phase alone exists in the tube, and the point *f*, is reached. It is well to state here, that the points on the curve between the eutectic temperature and the melting point, really do not represent the specific resistance of the solid phase, but the resistance of the tube multiplied by the cell constant. The specific resistance in the liquid phase increases with falling temperature. This is indicated by the part of the curve, *e a c*, which is quite normal as was to be expected. It is seen that there exists a point, *a*, at which the specific resistance in the liquid phase is equal to the so called specific resistance in the solid phase at the same temperature. This point was not found to exist in the case of acids which had been more carefully purified.



It was found that the specific resistance of the samples used, changed considerably with time and according to the previous history of the tube. This is to be expected, because, the action of the acid on the glass tube will result in the addition of impurities, which will continually decrease the value of such a high resistance as is being dealt with.

The change in resistance of the solid acid with change in temperature is evidently not a true temperature coefficient. It is due in a large part to three factors which are functions of the temperature.

There exists in the tube what may be regarded as a solution of a minute quantity of water in the acetic acid as solvent. As the temperature is lowered the acid gradually crystallizes out, with the result that the freezing point of the liquid portion is gradually lowered and the concentration of the water in the acetic acid is increased. Now the specific resistance of the liquid portion decreases on account of the increasing concentration of water. On the other hand, the effective cross section of the liquid between the electrodes gradually decreases and as a result the specific resistance tends to increase. Thirdly, the resistance tends to increase with decreasing temperature because of a true temperature effect. Examining the curve it is evident that the concentration factor is predominant above 0°C. This is to be expected as the increase in the concentration of the water in the solution part of the mixture, will be very rapid at first but will gradually decrease. The effect of the second factor, at temperatures near the melting point, will be small compared to the effect of the first factor. With decreasing temp., the volume of the liquid decreases more rapidly and so the second factor will have a gradually increasing effect until finally a temperature is reached when this effect will be equal and opposite to the effect of the first factor. At this point the curve bends and with lower temperatures the second factor is the predominant one, the resistance increasing with

decreasing temperature. The true temperature effect is to make the resistance increase with decreasing temperature, but as the temperature coefficient of this liquid is small, the shape of the curve is not materially affected by this factor.

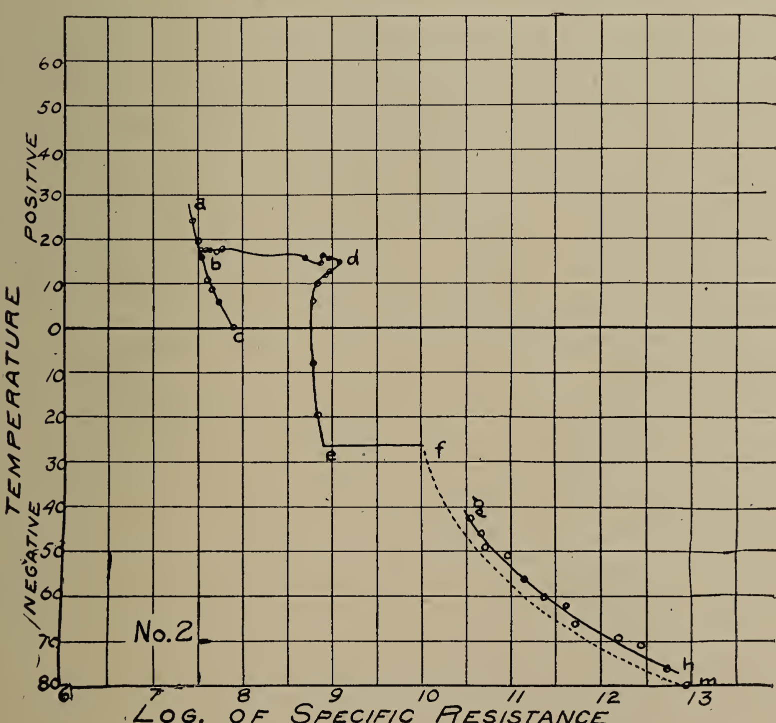
From the temperature of the bending point, down to the eutectic point, the resistance increases with the decreasing temperature. At the eutectic point, (–26.55°C)[1], the solution of water in acetic acid suddenly becomes solid, this mixture containing 59% of solid acid and 41% of ice. A considerable change in the resistance of the tube might be expected to occur at this temperature, and as the temp. is further decreased, the solid mixture should be found to have a true temperature coefficient.

To verify the last supposition, the resistance tube was surrounded by solid carbon dioxide and a temperature of —80°C[2] was finally obtained. This was measured by means of a thermocouple placed in the oil bath. As the temp. decreased rapidly it was noted that at some temperature between —25° and —30°C the resistance suddenly increased from approx. 8 x 10^8 to a value impossible to measure in the "network". The tube was then connected with an electrometer and condenser, as shown in figure 2. When the temperature of the resistance tube became equal to the temp. of the surrounding solid CO_2, –80°C, an E. M. F. was applied and the current passing thru the acetic acid was measured by the electrometer. The specific resistance of sample I was found equal to 1.00 x 10^{13} @ –80°C. Another sample No. 2, somewhat purer than No. I, was measured in a different tube @ –80°C and had a value of 9.92 x 10^{12}. Sample 2 was removed from the surrounding CO_2 and placed in a Dewar bulb. As the tube heated, resistance measurements were made at intervals, the thermocouple being read at the instant an electrometer

1 Dahms, Wied. Ann 60, 123, 1897.

2 Landolt und Bornstein, Tabellen page 76.

reading was made. In this manner values of the resistance at temperatures ranging from –80° to –47°C were obtained. Above –46°C the resistance was such that it was impossible to use the electrometer as a current measurer, so it was replaced by a *D'Arsonval* galvanometer. This instrument had a sensitivity of 3.52 x 10^9 amperes for one scale division and a resistance of 1900 ohms at room temperature. As the specific resistance of sample 2 varies from 9.92 x 10^{12} @ –80°C to 2.67 x 10^7 @ + 24°C, it is impracticable to plot these values by the direct method, so in curve No. 2, the logarithms of the specific resistance are shown plotted with the temperatures.



As the thermocouple indicates the temperature of the oil bath, the actual value of the temp. of the acetic acid, corres-

ponding to a particular electrometer reading will be lower than this. However the true temp. resistance curve shown as the dotted line, drawn from *m* to *f*, parallel to *h.g.* The part of the curve *ef* indicates clearly the discontinuity in resistance at the eutectic point; it shows that when −26.55°C is reached the resistance of sample 2, changes suddenly from 10^{10} to 8.8×10^8; this change being due to the solidification of the liquid portion between the electrodes.

When the temperature reaches 15°C, melting of the substance was apparent and the specific resistance decreases very rapidly from 1.27×10^9 to 3.52×10^7 @ 17.5°C, when liquefaction is complete. The part of the curve *ac*, shows the variation of the specific resistance with temp. in the liquid phase. Values of the specific resistance in the solid and liquid phases of sample No. 2, are given in table 3.

TABLE 3.

Sample 2 = Cell. const. $\equiv$ 4.8 $\approx$ M. P. $\equiv$ 16.4° C.

Temp.	State.	Sp. Resistance.
24.0	Liquid	2.67×10^{7}
19.4	"	3.22×10^{7}
17.8	"	3.34×10^{7}
15.7	"	3.60×10^{7}
10.8	"	4.48×10^{7}
6.0	"	5.55×10^{7}
0.	"	7.55×10^{7}
−19.9	Solid	6.48×10^{8}
− 8.0	"	6.14×10^{8}
+ 6.8	"	5.55×10^{8}
9.8	"	6.86×10^{8}
11.8	"	8.57×10^{8}
12.2	"	9.64×10^{8}
14.8	"	1.27×10^{9}
13.4	"	1.07×10^{9}
15.5	Melting	5.16×10^{8}
17.4	"	6.23×10^{7}
17.5	"	4.40×10^{7}
17.5	"	3.65×10^{7}
17.5	Liquid	3.65×10^{7}
−80	Solid	9.90×10^{12}
−79.1	"	5.55×10^{12}
−74	"	2.82×10^{12}
−73	"	1.51×10^{12}
−69	"	5.45×10^{11}
−65	"	4.19×10^{11}
−63	"	2.41×10^{11}
−59	"	1.45×10^{11}
−54	"	9.26×10^{10}
−52	"	5.50×10^{10}
−46	"	3.55×10^{10}

At temperatures below the eutectic point no liquid exists between the electrodes and as the amount of ice present is very small in comparison with the acetic acid (solid); there should exist a true temperature coefficient of resistance for the solid acid. Defining this as $\frac{1}{R_t}\frac{d\,R_t}{d\,T}$ it can be determined from the curve 2, by graphical methods and it is found to vary from 0.3 @ —43°C to 0.25 @ –70°C. The writer[1] found the temp. coeff. of ice to vary from 0.6 @ –2° to 0.12 at –12° and with lower temperatures it increases in value. It thus appears that solid acetic acid is like ice in that it has a very great temperature coefficient of resistance. The temp. coeff. for sample 2 in the liquid phase was calculated in a similar manner and found equal to 0.04 @ 14°C.

To determine the effect of adding considerable quantities of water to the acid, the tube was filled with a 2% solution of water in acetic acid, (sample No. 3), and measurements were made at different temperatures.

A comparison of the specific resistance, temp. coeff. and the melting points for samples 1, 2 and 3 is given in table 4.

TABLE 4.

Sample.	State.	M. P.	Temp.	Res. Sp.	Temp.-Coett.
1	Liquid	15.9	14° c.	1.3×10^7	.04
2	"	16.4	14	3.8×10^7	.04
3	"	13.2	14	1.2×10^6	.03
1	Solid		12	1.7×10^7	
2	"		12	8.9×10^8	
3	"		12	2.2×10^6	
1	"		−80	1.0×10^{13}	25
2	"		−80	9.9×10^{12}	
3	"		−80	8.4×10^{11}	

1 Trans. N. S. Ins. of Sc. XIII., part 2, page 143.

The evidence appears to be conclusive, that at temperatures above the eutectic, practically all the current passing thru the acid is conducted by the liquid portion of the mixture between the electrodes. So the term, *specific resistance of the solid at temperatures above the eutectic* is meaningless, and the values obtained for the specific resistance and plotted on curves 1 and 2 merely indicate the resistance of thin columns of the solution of acid and water between the electrodes, multiplied by the cell constant. To obtain a true value for the specific resistance of the solid acetic acid, the temperature must be kept below the eutectic point.

Comparing the values of the specific resistances in table 4, it may be seen that small variations in the quantity of water present greatly affect the specific resistance at temperatures above −26.55 in the solid and liquid phases, while below the eutectic point, the specific resistance is not materially affected by the presence of small quantities of water. At—80°C the specific resistance of sample 3 is considerably smaller than that of samples 1 and 2 at the same temperature. This might be expected and it is probably due to the comparatively large amount of water in the solid form, stretching from one electrode to the other, thus increasing the conductivity of the mixture of ice and acetic acid, as the former has a greater conductivity than the latter. In tubes 1 and 2, the amount of water present is so small, that when frozen, it does not occupy sufficient volume to materially affect the sp. resistance.

Summary.

1. Three satisfactory methods have been investigated and used in the measurement of high electrolytic resistances.

2. The specific resistance of acetic acid in the solid and liquid phases, has been measured at temperatures ranging from −80°C to +27°C and sudden changes were found at the melting and eutectic points.

3. The resistance in the solid phase above the eutectic point is found to vary in a peculiar manner, as the temperature changes. This variation has been explained.

4. The effect of small quantities of water on the resistance of the acid has been investigated and explained and it has been shown that the conductivity of the acid in the solid state above the eutectic point, is due almost entirely, to the presence of this water.

5. The temperature coefficient in the liquid phase was found to be nearly constant and equal to 0.04. In the solid phase it varies from 0.30 @ –43°C to 0.25 @ –70°C.

In conclusion I wish to thank Dr. Bronson for the inspiration and help which made this work possible.

Dalhousie University, Halifax.

March 9th, 1914.

Notes on the Analysis of "Iron-stone" by Hubert Bradford Vickery,* Dalhousie University, Halifax.

Read 19th of January, 1914.

Iron-stone is the name which is applied in popular usage to the rock which is at present finding considerable application as a building material in and about Halifax. For this purpose it has several advantages, and some disadvantages. On account of its structure and the presence of well-developed joint-planes, it is quarried into rectangular blocks with a fair degree of ease. The flat surfaces of the planes allow of its being built into a smooth wall, and the familiar iron-rust stains, where the rock has been exposed to the weather allow of artistic effects being produced by placing the colored blocks in symmetrical positions.

A decided disadvantage, however, lies in the difficulty which has been experienced in finding a cement which sticks closely enough to the stone to prevent seepage of water through the masonry, thus producing unsightly stains on the interior wall. This difficulty is being obviated, it is hoped completely, in the case of the new Science Building at Studley by building the wall double, using iron-stone outside and granite as a lining, for ordinary cement forms with granite a weather-proof wall.

From the geological standpoint, iron-stone is metamorphosed shale of great age, belonging as it does to the Pre-Cambrian period. In the course of geological time it has become greatly changed so that the orginal shale has now become a hard slate. Several influences have combined to produce this result. It has been very severely folded, in some places even crumpled, so that the originally flat-lying beds are now found in all attitudes, even approaching the per-

* Contributions from the Science Laboratories of Dalhousie University (Chemistry).

pendicular, and the great folds may be traced all over the country wherever exposures occur.

Another important metamorphosing influence was the intrusion of great masses of granite in Devonian time. The effect of this was to harden the slate by baking it and to produce many minerals which give a characteristic spotted appearance as the contact with the granite is approached.

It is this hardened slate from near the contact which has received the name of iron-stone, and which is used for building purposes. Microscopic examinations of a series of sections of the slate taken from the proximity of the granite contact made last year by Prof. D. S. MacIntosh, gave evidence that the folding took place prior to the intrusion and also showed the development of a series of minerals, such as cordierite, in small ovoid patches found even at considerable distance from the contact, slender crystals of andalusite found nearer and also several other less prominent minerals, such as biotite, sericite and muscovite. The small amount of carbonaceous material in the orginal shale was changed to graphite and feldspar and quartz particles are found. Up to the present no fossils have been discovered, a circumstance which points alike to its great age and the severe metamorphosis that it has undergone.

As found in most localities, it is a hard dark grey rock, characterized by red stains of ferric oxide where it has been exposed to the action of the weather, of a rather homogeneous structure and stony appearance. Bands are found which contain so much silica and are so hard that they exhibit the phenomenon of conchoidal fracture. As the granite contact is approached the slate changes its appearance slightly and becomes what is known as spotted slate due to the development of minerals. Patches and small crystals of pyrites are common and under the influence of the weather, some of the minerals have dissolved out, giving a pitted surface.

The specimen used in the following analysis was procured from the grounds at Studley. It was quarried from across the North West Arm, near Halifax, in the old King's Quarry, a few hundred yards from the contact with the granite. It was slightly mineralised but care was taken to select a specimen which had not been weathered to a sufficient extent as to become stained. By the courtesy of the Technical College it was reduced to a very fine flour in their machines, and was then very carefully mixed. The actual specimen analyzed was obtained by selecting small portions from all parts of the mass, and these portions were again ground in an agate mortar until no grit was perceptible. A weighed-out portion of this was taken and thoroughly mixed with about eight parts of sodium carbonate, placed in a platinum crucible, and two more parts of sodium carbonate placed on top.

The crucible was heated gently at first and then more violently until a clear fusion took place, the crucible being meanwhile loosely covered. On cooling, the crucible and its cover were placed in a solution of 50^{cc} hydrochloric acid in 100^{cc} of water and allowed to thoroughly disintegrate. The residue of silica was filtered off and washed, and the filtrate evaporated to dryness and dehydrated on the water-bath for two hours, the residue moistened with concentrated hydrochloric acid, and dissolved in about 150^{cc} water, filtered and washed.

A second evaporation and dehydration was found necessary in only a few cases. The silica was carefully ignited to constant weight. It was then treated with a few drops of concentrated sulphuric acid and hydrofluoric acid and warmed to expel the silicon tetrafluoride and finally the sulphuric acid and the crucible again weighed. The difference of these two weighings gave the silica contents of the iron-stone which was found to be 58.05%. The residue in the crucible, which was chiefly iron and aluminum oxide, amounted to .0140 g. and as an even gram portion had been taken

this reads 1.40% which will be added to the determination of iron and aluminium oxides.

The filtrates from the silica were combined and the iron and aluminium contained determined in the following way:—

A few drops of bromine water were added and the solution boiled to oxidize any ferrous iron present, and a considerable volume of ammonium chloride added and the solution made slightly alkaline with ammonium hydroxide. The precipitated hydroxides were filtered off and washed carefully, dried in the oven and ignited to constant weight. This with the weight of the iron and alumina carried down by the silica gave a weight of .3225 g. or 32.25% of combined iron and aluminium oxides, assuming the iron to be all in the ferric condition.

The iron content was determined by preparing another sample as before, removing the silica and making the solution up to standard volume. Two accurate fractions were then taken and one titrated direct with standard permanganate solution to obtain the proportion of ferrous iron. This process is open to some objection as it is very difficult to ensure that no oxidation of the ferrous iron should take place during the processes of grinding the sample and of fusion, and the proportion calculated from it can only be appromixately correct. The other fraction was evaporated with sulphuric acid and the hydrochloric acid expelled. It was then reduced by means of a Jones reductor and titrated with standard permanganate. Thus the ratio of the ferrous iron to total iron was established and from it the proportions of the two oxides calculated, proving to be ferrous oxide 1.72%, ferric oxide 4.51%—total iron 6.23%.

The calcium and magnesium were determined by the Richards method. This method is based upon the fact that the amount of magnesium occluded by the calcium oxalate precipitate. depends upon the concentration of magnesium

molecules present. Hence the ionization of the magnesium is favoured in every way possible.

In detail the procedure consists in diluting the filtrate from the iron and aluminium to about 500^{cc} and adding ammonium choride in some quantity, and to precipitate the calcium a boiling solution of oxalic acid is added, which contains three or four equivalents of mineral acid. A few drops of methyl orange are added and the solution neutralized very slowly (at least half an hour for complete neutralization). Considerable excess of hot ammonium oxalate is added and the solution allowed to stand some hours and the calcium oxalate filtered off and washed chloride free with a one per cent. solution of ammonium oxalate. The precipitate on careful ignition yielded decimal 67% of calcium oxide.

The magnesium was determined by evaporating the filtrate until salts began to crystalize out and then diluting until these just dissolved. Then exactly one-third volume of strong ammonia was added and an excess of sodium hydrogen phosphate. The precipitate formed is magnesium ammonium phosphate and this on ignition yields magnesium pyrophosphate from which the magnesium oxide content was calculated, proving to be 1.18%.

Sulphur was determined by taking fresh samples of iron-stone and fusing with ten parts of a mixture of four parts sodium carbonate with one of potassium nitrate. The samples were very carefully mixed and fused by heating the crucible placed in a hole in an asbestos board to deflect any gases from the flame which might contain sulphur. When all action had apparently ceased the residue was cooled and repeatedly extracted with boiling water and finally with boiling dilute sodium carbonate solution. The solution thus obtained was made acid, evaporated and the silica dehydrated and the nitric acid expelled by moistening with hydrochloric acid, and again evaporating. The silica was then filtered off and

the filtrate diluted to 400^{cc} brought to boiling and hot barium chloride solution added very slowly in slight excess and the solution allowed to digest for some hours. From the precipitate of barium sulphate the sulphur content was calculated and found to be 1.67%.

The water contained in combination was estimated by igniting a fresh sample for some hours in a covered crucible to constant weight. This was found to give a proportion of volatile matter of 6.49%. As this, however, probably includes the sulphur a determination of the sulphur contained in the residue was made showing that over two-thirds of the total sulphur had been driven off. This weight subtracted from the total loss of weight on ignition gave the loss due to the volatilization of the water which was found to amount to 5.23%.

These results may be summarized as follows:—

"Iron-stone."

Silica		58.05	
Combined Oxides: Alumina	26.02		
Ferrous Oxide	1.72		
Ferric Oxide	4.51	32.25	
Calcium Oxide		.67	
Magnesium Oxide		1.18	
Sulphur		1.67	
Water		5.23	
			99.05

A partial analysis of another sample of iron-stone was made, the specimen being taken from a rather silicious band very near the granite contact and with the minerals quite highly developed. The results were:—

Silica	64.48
Combined Oxides	26.06
Sulphur	.32
Magnesium Oxide	1.56
Volatile matter, including water and probably some sulphur	2.68

These figures show that considerable variation in composition may occur and the low proportion of volatile matter and sulphur and the high silica are significant of the effect of the granite intrusion upon the slate in its immediate vicinity.

Although the microscope reveals the presence of feldspar, it is in such small quantities that no effort was made to estimate the alkalis.

The following tables give the analyses of typical slates.

A black roofing slate from Vermont gave:*

Silica		59.7
Combined Oxides: Alumina	17.0	
Ferrous Oxide	4.9	
Ferric Oxide	.5	22.4
Magnesium Oxide		3.2
Calcium Oxide		1.3
Alkalis		5.2
Water		4.1
Other Oxides and Carbon		4.3
		——100.3

A slate from Wales gave:

Silica		60.5
Combined Oxides: Alumina	19.7	
Ferrous Oxide.	7.8	27.5
Magnesium Oxide		2.2
Calcium Oxide		1.1
Akalis		5.4
Water		3.5
		——100.2

* Pirrson's Rocks and Rock-Minerals, page —

Integral Atomic Weights, Part 1.—By Frank William Dodd, Assoc. Mem. I. C. E., Weymouth, England.

Read 11th November, 1912.

This constitutes a suggestion that the accepted series of atomic weights are fractional parts of a series of higher or Integral Atomic Weights which more correctly represent the properties and constitution of the atoms, except in the matter of weight.

The author was led to make a large number of calculations with a view to find traces of such a series of Integral Atomic Weights, and, at length, found that if the accepted atomic weights were scaled off as ordinates at convenient horizontal distances, and a curve drawn, as shown in Fig. 1, it was possible to draw certain horizontal lines AB, CD, EF, GH, JK, above the curve, in such positions that the specific gravities of the few elements beneath any given horizontal line were a very simple function of the distance between the horizontal line and the curve at that point. Not only so, but the distances of these horizontal lines from the base line were simple functions of of each other.

That is to say, referring again to Fig. 1, that the upper or dotted portions of the atomic weight ordinates, which we may call super-ordinates, are very simple functions of the specific gravity of the elements to which they refer, and that the heights of the lines AB, CD, EF, GH, and JK, above the base line, bear the simple proportions 128, 132, 136, 232, 224, all but one of which are multiples of 8 and the remaining one a multiple of 4.

The super-ordinate divided by 1.8 gives the specific gravity approximately.

The author was led to complete the series but found that in most other parts of the curve a line had to be drawn for

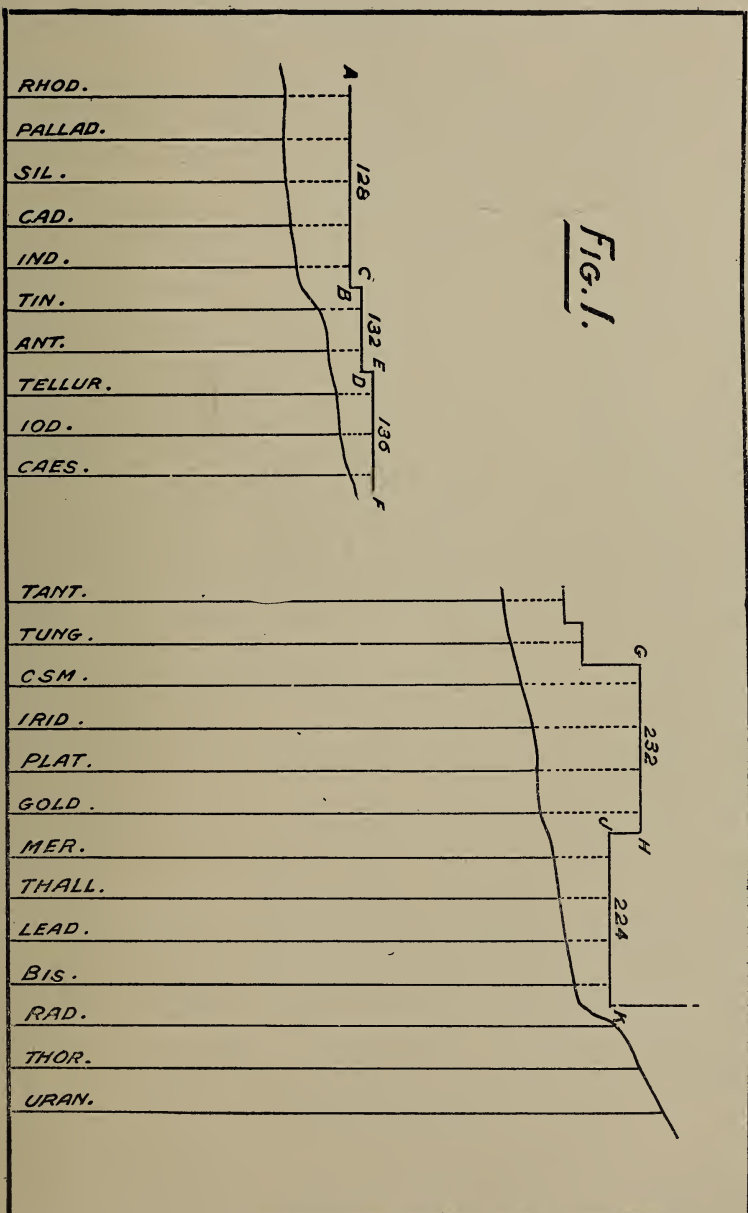

RHOD.
PALLAD.
SIL.
CAD.
IND.
TIN.
ANT.
TELLUR.
IOD.
CAES.
A
B
C
D
E
F
128
132
136
TANT.
TUNG.
OSM.
IRID.
PLAT.
GOLD.
MER.
THALL.
LEAD.
BIS.
RAD.
THOR.
URAN.
G
H
J
K
232
224

FIG. 1.

each single element. Nevertheless, the heights of these lines persisted in approximating to multiples of 4 or 8 with a few exceptions. Where it is a multiple of 3, that will crop up repeatedly in the same group of elements. Similarly when it is a multiple of 5. This happens, by the way, in the pentad group, which is decidedly interesting.

He afterwards found that the ratio $\frac{\text{super-ordinate}}{1.8}$ approximated more closely to the specific gravity if the heights of the horizontal lines above the base were measured with 1.008 (atomic weight H) as a unit instead of with 1 as a unit.

The number of units in the ordinates running from the base line right up to the horizontal lines may be called the "Atomic Multiples"; and the Atomic Multiples × 1.008 are what have been called above, the "Integral Atomic Weights."

A list is given in Fig. 2, of these Atomic Multiples, arranged after the manner of Mendeléeff's table.

It will be found that,

$$\text{Specific Gravity} = \frac{\text{Integral At. Wt.—actual At. Wt.}}{1.8}$$

with an average error of 0.55. A large number work out with great accuracy.

Manganese is not very amenable to the system, but it should be remarked that it stands very much alone in its group any way.

It is well to keep the two factors of the Integral Atomic Weight—namely the Atomic Multiple and the unit of 1.008 —separately in mind, as it may be found desirable to alter the the Atomic Mutltiple for any element, or the unit for all the elements in order to get more precise results later on.

Melting Points.

These Atomic Multiples have a very distinct relation to the melting point curve of the elements. As the list of the

FIG. 2.

	Li. 8	Be 12	B 15	C 16				
	Na.24	Mo.27	Al 32	Si.32	P.35	S.36	Cl.36	
	K.40	Ca 42		Ti.54	V.60	Cr.64		Fe 68 Co. 72 Ni. 72
	Cu.80	Zn 80	Ca 80	Ge 80	As 84	Se 84	Br.86	
	Ru.88	Sr 88	Y.96		Ni.105	Mo.108		Ru. 116 Rho. 128 Pd. 128
	Ag 128	Cd 128	In.128	Sn 132	Sb 132	Te 136	I.136	
	Cs.136	Ba 144		Ce 152				
					Ta.204	W.216		Os. 232 Ir. 232 Pt. 232
	Au 232	Hg 224	Tl.224	Pb 224	Bi.224			
		Ra.248 ?236		Tn.248		U.272		

elements progresses, the Atomic Multiples either remain constant or rise (with one exception).

While they remain constant, the melting point curve falls rapidly. Where they materially increase, the melting point rises abruptly. Small increases only just check the fall of the melting point curve or may just give a slight rise, thus forming the double periodicity humps. This is most readily seen by marking the Atomic Multiples on a melting point curve. It will be seen that in the one instance where the Atomic Multiple falls the melting point drops below zero.

Specific Heat.

The Integral Atomic Weight of an element multiplied by the specific heat of the element is a more constant quantity than the ordinary atomic weight of an element multiplied by its specific heat, the departure from a mean being reduced by about 30 per cent. In the lower parts of the scale the reduction of variation is much more than this.

Conclusions.

The author thinks there is strong evidence that these suggested Integral Atomic Weights are a real function of their respective elements, and if they be accepted the inferences are:—

(*a*) That the heavier elements are built up from the lighter elements with probably hydrogen, helium, and possibly lithium largely as constituents, these sub-atoms being conjoined in some vibratory system which renders a part of their material unnecessary to the structure of the complex atom; for if the Atomic Multiple, or the Integral Atomic Weight be taken as proportional to the number of ultimate sub-atoms constituting any given atom, then the excess of these magnitudes over the accepted atomic weight may be

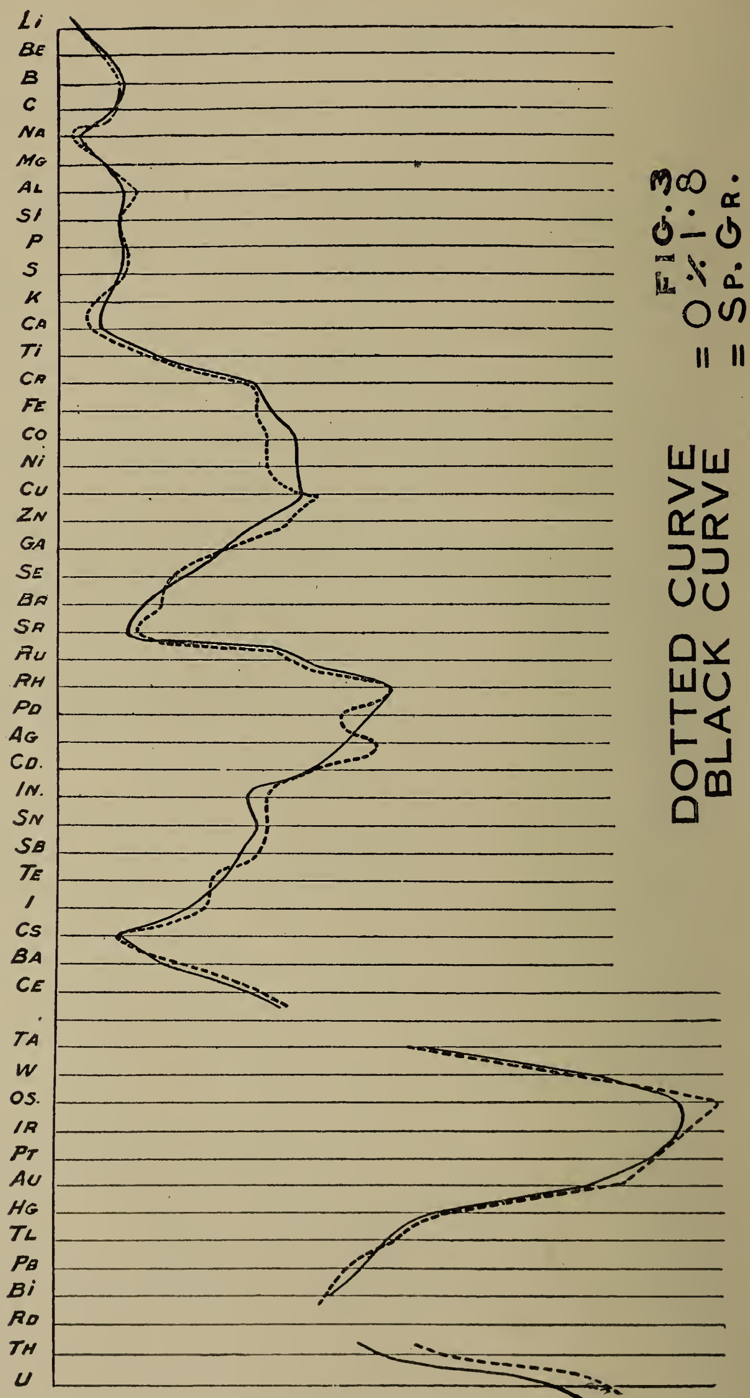
considered proportional to the loss of material in the formation of the atom.

(*b*) That the quantity of missing material is a very simple function of the closeness of the combination: that is to say of the density of the substance.

(*c*) That the specific heat of an element depends more upon the number of ultimate sub-atoms in its main atom, than upon the actual weight of the said main or complex atom.

(*d*) That with a given number of sub-atoms the melting point is a direct function of the quantity of missing material, so that melting point curve and specific gravity curve are similar so long as the number of sub-atoms (i. e., the Atomic Multiple) remains constant.

A curve showing the closeness of agreement between actual specific gravities and those worked out by the above method, is appended (Fig. 3).


Li
Be
B
C
Na
Mg
Al
Si
P
S
K
Ca
Ti
Cr
Fe
Co
Ni
Cu
Zn
Ga
Se
Br
Sr
Ru
Rh
Pd
Ag
Cd.
In.
Sn
Sb
Te
I
Cs
Ba
Ce
Ta
W
Os.
Ir
Pt
Au
Hg
Tl
Pb
Bi
Rd
Th
U
FIG. 3
DOTTED CURVE = O/1·8
BLACK CURVE = SP. GR.

Integral Atomic Weights, Part 2. — By Frank William Dodd, Assoc. Mem. I. C. E., Weymouth, England.

(Revised August, 1914.)

Since reading the short paper on this subject in November, 1912, at a meeting of the Nova Scotian Institute of Science, the author has given further consideration to the subject, and has also received and considered numerous criticisms.

The most important of these criticisms and one which, being fairly obvious, was advanced from several quarters, was based on the fact that the specific gravity of an element is not a definite and inherent quantity, but is dependent upon temperature and other conditions, physical and mechanical, and may vary widely for the same element.

The author's first paper may be summarized in a sentence. It suggested that if the specific gravity of the elements of a group multiplied by a suitable factor be added to the atomic weights of those elements, a series of numbers is obtained which very strongly suggests a system of Integral Atomic Weights, and the building up of the heavier elements from the lighter.

The question arises,—which specific gravity, seeing that an element may have a great range of specific gravity?

In the present paper I have to suggest that each element has what may be termed a Natural Specific Gravity, any departure from which may be regarded as more or less accidental. This Natural Specific Gravity results from the combination of certain volumes in a definite manner, analagous to the mode of combination of gases; producing a resultant compound with a specific volume having a definite

and simple relation to the specific volumes of the constituents.

To illustrate this suggestion the following table, Fig. 1, is arranged showing the actual specific gravities of the elements in Group I in comparison with what I suggest are the Natural Specific Gravities. Gold is omitted as it seems to belong to another group as far as this system is concerned. The agreement between the observed specific gravities and the Natural Specific Gravities based on the Atomic Multiples, affords a confirmation of the real connection of the Multiples with the actual physical properties of the elements.

With this new suggestion in view the author invites attention to the accompanying table, Fig. 2, relating to Group V, in which the Atomic Multiples are worked out from the Natural Specific Gravities. In other words—one assumption is made and one only—namely that the Natural Volumes of this Group are as shown on diagram Fig. 3. This shows only three Natural Volumes for the eight elements. It is thought that the diagram will show that the assumption is not a rash one.

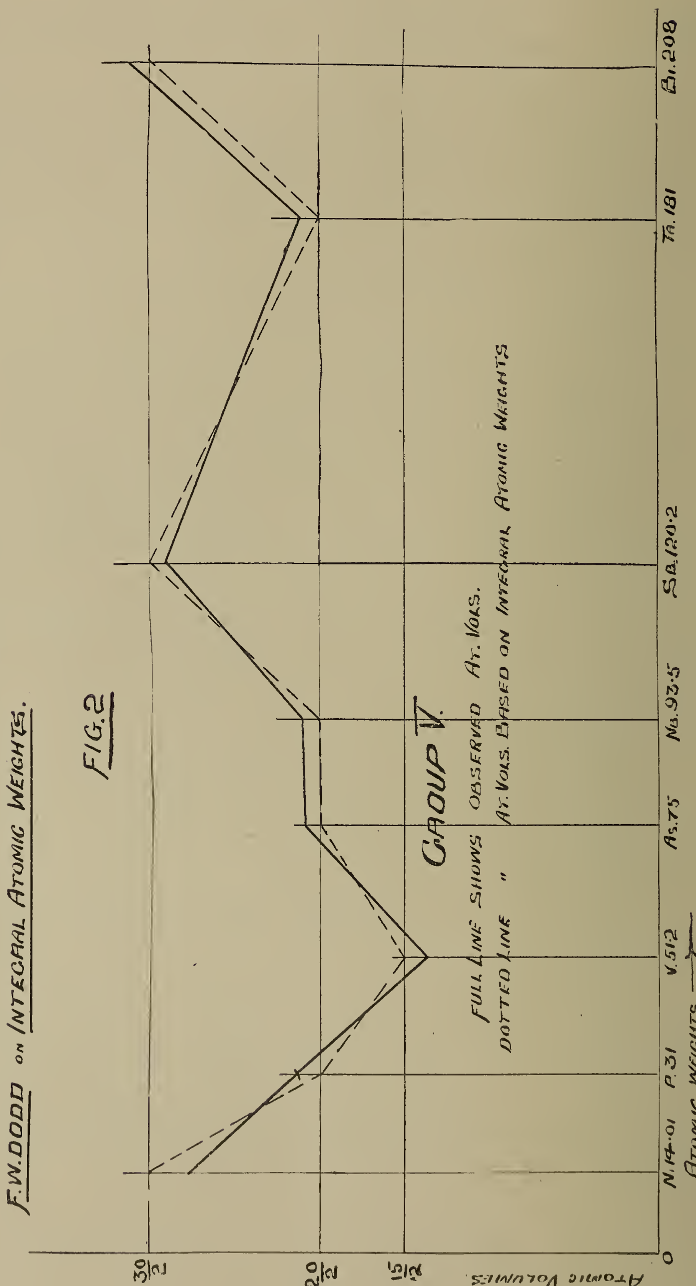
The Atomic Multiples arrived at, show very close approximation to multiples of 5, so close that it is at least 1,000,000 to one against this being a mere chance result.

As I foresaw in reading my first paper, some of the Multiples have had to be slightly modified on further consideration, and as the subject develops.

F. W. DODD ON INTEGRAL ATOMIC WEIGHTS

FIG. I

	Atomic Multiple	Natural Volume	Natural Specific Gravity	Nat Spec. Gr Reduced to Water Basis	Observed Specific Gravity for Comparison
Li. 7	8	$\frac{24}{2}$	$\frac{2}{3}$	·5883	·534
Na. 23	24	24	1	·8825	·9735
K. 39·1	40	40	1	·8825	·896
Cu. 63·57	80	8	10	8·8250	8·925
Rb. 85·45	88	44	2	1.7750	1·532
Ag. 107·88	120	10	12	10·5900	10·530
Cs. 132·81	136	68	2	1.7750	1·870


F.W. DODD on INTEGRAL ATOMIC WEIGHTS.
FIG. 2
GROUP V.
FULL LINE SHOWS OBSERVED AT. VOLS.
DOTTED LINE " AT. VOLS. BASED ON INTEGRAL ATOMIC WEIGHTS
0
N.14·01
P.31
V.51.2
As.75
Nb.93·5
Sb.120·2
Ta.181
Bi.208
ATOMIC WEIGHTS
30
20
15
ATOMIC VOLUMES

F.W. DODD ON INTEGRAL AT. WEIGHTS

FIG. 3

ELEMENT	SUGGESTED ATOMIC MULTIPLE	NATURAL VOLUME	NATURAL SP. GRAVITY	ATOMIC WEIGHT PLUS NAT. SP. GR. × 1·1325	ERRORS i.e. DEPARTURE FROM SUGGESTED MULS.	
N. 14.01	15	$\frac{30}{2}$	1·0	15·1425	·1425	
P. 31	35	$\frac{20}{2}$	3·5	34·96375	·03625	
V. 51·2	60	$\frac{15}{2}$	8·0	60·26	·26	
As. 75	85	$\frac{20}{2}$	8·5	84·62625	·37375	
Cb. 93·5	105	$\frac{20}{2}$	10·5	105·39125	·39125	
Sb. 120·2	130	$\frac{30}{2}$	8·66	130·01500	·01500	
Ta. 181	205	$\frac{20}{2}$	20·5	204·1625	·8375	
Bi. 208	225	$\frac{30}{2}$	15·0	224·9875	·0125	

MEAN ERROR IN A CHANCE COMBINATION WOULD BE 1·25

The Occurrence of European Birds in Nova Scotia.—By Harry Piers, Curator of the Provincial Museum of Nova Scotia, Halifax, N. S.

[Read, in part, 9th December, 1912; revised to 25th June, 1914.]

At intervals there have been taken on the eastern shores of the Western Hemisphere, birds which belong more strictly to the Old World, and the purpose of the paper is to record a few recent occurrences of the kind in Nova Scotia, such as those of the European Widgeon, the European Teal, and the Lapwing, as well as to bring together some particulars of all such previous records as have come to my knowledge. To this is added some information about the Dunlin and Wheatear, which have been, apparently erroneously, stated to have been taken in this Province.

Of the nine species mentioned, all belong to the so-called "Water Birds." Two of these are members of the order *Anseres* (Ducks, etc.), one of the *Paludicolæ* (Rails, etc.), and the remaining six of the *Limicolæ* (Snipes, Sandpipers, etc.). Nearly all of them are known to occur in Greenland or Iceland, and their breeding range is within or approaches the Arctic Circle. We have no instance, that I know of, of a bird with an exclusively more southern breeding area, occurring in Nova Scotia.

The few dates available for the occurrences given, are as follows, arranged in order of months: 9 Jan., 14 Feb., 17 Mar., 23 and 27 May, 1 and 28 Sept., Oct., and 12 Dec. Although these data are far too scanty to form any definite conclusions, one is led to think that the occurrences may be mostly referable, as would be expected, to the vernal and autumnal migrations. The winter and very early spring dates, however, are difficult to account for, unless the birds

had remained here after the fall migration, whereas one would expect them to have passed southward to escape the severe season of the year. The March record could be accounted for by the bird being then in transit northward under the vernal migratory impulse.

Judging by the evidence, we are fully justified, I think, in assuming that these north-breeding water-birds have arrived on our coast by way of Iceland, Greenland, and Labrador or Newfoundland, which is the usual route taken by European birds coming to eastern America; and that none of them have ever flown directly across the whole Atlantic Ocean, as is a popular belief among many people who are not ornithologists. At the time of migration, they have, no doubt, been turned in our direction by heavy easterly gales or other stress of weather, rather than from any mere individual motive or impulse. The prevailing winds in the North Atlantic are from the southwest and west, with easterly eddies about the coast of Greenland, but a flight is apt to encounter an adverse easterly gale at any time. In passing to the mainland of North America, the greatest flight these storm-strayed individuals would have to undertake, would be only about the same as that they had been in the habit of successfully taking from the British Isles to Iceland.

Of course, some of our American birds are similarly met with casually in the Eastern Hemisphere, as in the case of our Baldpate or American Widgeon, and other birds, which are recorded in lists on the east side of the Atlantic.

European Widgeon. *Mareca penelope* (Linn.). A.O.U. No. 136.—A male of this species was shot at Melbourne, on Chebogue Harbour or River, about five miles southeast of Yarmouth, Yarmouth county, Nova Scotia, on 9th January, 1912, by James Allen. It was mounted by Benjamin Doane, taxidermist of Yarmouth, and in November, 1912, was

purchased from him and added to the collection of the Provincial Museum at Halifax (accession no. 3829). The head and neck are rufous-brown; crown creamy-white. Length, as mounted, about 18.00 inches; wing, 9.85 inches; tarsus, 1.40 inches; bill, 1.32 inches. E. C. Allen, of Yarmouth, who first informed me of the taking of the bird, said that there were two other ducks like it in its company at the time; but these, I think, may have been Baldpates (*Mareca americana*) with which it is sometimes found.

This, I think, is the first fully-recorded instance of this European bird's occurrence in Nova Scotia, for although mentioned in Andrew Downs's "Catalogue of the Birds of Nova Scotia" (*Trans. N. S. Inst. Nat. Sc.*, 1888, vii, 147), with the mere statement "rare," no other particuars are given, and it is not included in Dr. J. B. Gilpin's "Semi-annual Migration of Sea Fowl in N. S." (*Trans. N. S. I. N. S.*, v, 138). The word "rare," at any rate is not sufficiently strong to correctly indicate it as a mere accidental visitor. The locality "Nova Scotia" given in Coues's *Key to N. A. Birds* is referable back (per *The Auk*, Jan., 1889, p. 64) to Downs's statement. M. Chamberlain, in his edition of *Nuttall's Ornithology*, vol. ii, 1891, p. 313, says that "every year more or less examples are seen along our coast from Nova Scotia to Virginia". Chapman in his *Handbook of Birds of Eastern North America*, 1912, p. 194, says the species "is of rare but regular occurrence in Eastern North America," and has been taken in New York, Nova Scotia, Newfoundland, and Greenland, south to Nebraska, Missouri, Indiana, Ohio, North Carolina, and Florida, as well as in Alaska, British Columbia, and California. All the Nova Scotia references, I am convinced, can be referred to Downs's vague note.

The species is a native of the northern part of the Eastern Hemisphere, and it breeds within the Arctic Circle in Iceland, and very possibly may be found breeding in Greenland. Its somewhat regular casual occurrence in parts of North America,

and its being found in Iceland, Greenland and Newfoundland, make it almost doubtless that it finds its way here, as other species do, under stress of weather, along that route, which would furnish resting places, and that it does not fly directly across the Atlantic from the east.

It has been mentioned that our own American Widgeon or Baldpate (*M. americana*) occurs casually in Europe. It breeds as far north as lat. 68°, which is about the same as that of Iceland.

European Teal. *Nettion crecca* (Linn.). A. O. U. No 138.—The first known occurrence of this European species in Nova Scotia, was a specimen taken near Halifax, by Dr. J. B. Gilpin, on 1st September, 1854. It was mounted by the late Andrew Downs and shown at the Dublin International Exhibition of 1865, and was purchased there by Sir Arthur Guinness for his collection. (See Gilpin, "Sea Fowl of N. S.," *Trans. N. S. Inst. Nat. Sc.*, v, 141; Chamberlain, *Catalogue of Canadian Birds*, 1887; and Downs, "Catalogue of Birds of N. S.," *Trans. N. S. I. N. S.*, vii, 148).

Another specimen, an adult male, not hitherto recorded, was shot at Mineville, near Lawrencetown, Halifax county, N. S., on 14th February, 1913, by J. R. Shaw of Mineville; and was purchased by the Provincial Museum (accession no. 3980). The long scapulars are creamy-white internally, and black externally, producing two very conspicuous contiguous longitudinal bands, as is typical in this species. There seems to be also a very slight difference in the tint of the green of the speculum of this specimen as compared with that of the Green-winged Teal. Another duck which was shot in company with the one just mentioned, lacks these bands, and is evidently a male of the ordinary Green-winged Teal (*Nettion carolinensis*), which otherwise much resembles it. This specimen is also in the Museum collection (accession no. 3981.) The two above records are the only ones for this province known to me.

This species is a native of Europe, breeding as far north as Iceland, and a few specimens have been killed in Danish Greenland and one in Labrador, and it occurs casually on the North American Atlantic coast as far south as Washington, D. C.

CORN CRAKE. *Crex crex* (Linn.). A. O. U. No. 217.—The late James McKinlay, a local ornithologist of Pictou, N. S., in October, about the year 1873, while snipe shooting on a wet grassy spot about a mile in the rear of Pictou town, shot a specimen of this Old World species. It remained long unidentified in his collection, until it was examined by Frank M. Chapman, author of the *Birds of Eastern North America*, when he visited Pictou in July, 1898. It is the only record for this province. (*Vide* information furnished me by Mr. McKinlay, 21st July, 1898, and his note in *The Auk*, Jan., 1899 ; also Macoun's *Cat. of Can. Birds*, 1909, p. 154.) This bird is a native of Europe and northern Asia, and occurs casually in Greenland, Newfoundland, and as far south as New Jersey and the Bermudas. Sandford, Bishop and VanDyke (*Water-fowl Family*, 1903, 294) say it breeds regularly in Greenland, but I do not find this noted in other works.

DUNLIN. *Pelidna alpinia alpinia* (Linn.). A.O.U. No. 243.—This Old World representative of the American Red-breasted Sandpiper is taken occasionally in Greenland, and has been also recorded as accidental on the west side of Hudson Bay, on Long Island, N. Y. and at Washington, D. C. It breeds in Scotland and the islands to the north thereof, and occasionally in England and Iceland, etc. north to latitude 74°.

Gilpin, is his "Shore Birds of Nova Scotia" (*Trans. N. S. Inst. Nat. Sc.*, v, 1882, p. 384), says that he had never met with the Dunlin in Nova Scotia, and he does not mention it in his list on page 385. On page 386 he says, "I have no distinct recollection of . . . seeing Dunlin's Sandpiper," but

adds, "I think there is a Dunlin immature bird in the Halifax Museum." A specimen in the Provincial Museum, unaccompanied by exact locality or date of capture, which is evidently the one referred to by Gilpin, is apparently a Red-backed Sandpiper in winter, or some state of immature plumage, its measurements being as follows: wing, 4.66 inches; tarsus, 1.00 inch; bill, 1.40 inches; middle toe with claw, .95 inch; middle toe without claw, .85 inch. These measurements all exceed the maximum ones of the Dunlin as given in Chapman's *Handbook.*

Macoun, in his *Catalogue of Canadian Birds,* 1909, p. 177, gives it as a "rare migrant in Nova Scotia," appending to this statement the name of Harold F. Tufts. then of Wolfville, N. S. Mr. Tufts, in his "Notes on the Birds of King's County, Nova Scotia" (*Ottawa Naturalist,* xii, Dec. 1898, p. 175) gives the Red-breasted Sandpiper (*Tringa alpina pacifica,* Coues, =*Pelidna alpina sakhalina,* Vieill.) as "a rather uncommon autumn migrant; observed on the Long Island beach during September;" but he makes no reference in that list to the Dunlin (*P. alpina alpina*).

This note in Macoun's list I had at first thought must have been intended to refer to the Red-back Sandpiper, under which latter name he makes no specific reference to Tuft's record in the *Ottawa Natuarlist,* although he speaks of it generally as "a rare migrant along the Atlantic coast." Furthermore, although there is no doubt that the Dunlin might be expected to occur here accidently, yet the expression "rare migrant" could not adequately represent the mere casual nature of such a bird's occurrence in this Province; whereas it does express the relative rarity of the Red-backed Sandpiper.

Dr. Harold F. Tufts, now of Jamaica Plain, Mass., in answer to a recent enquiry of mine respecting the beforementioned record, writes: "In regard to the Dunlin, I remember well the bird I took for it, —it was shot at Long Island beach,

near Grand Pré, King's county, in the latter part of September, 1898 or 1899—I think 28th September, 1898. I fired into a small flock of sandpipers and brought down a White-rumped Sandpiper, two Red-backed Sandpipers, and one which differed from the latter and which to the best of my ability to identify with the aid of Chamberlain's revision of Nuttall's Ornithology, I decided was the Dunlin, which is said to occur not infrequently on this side of the Atlantic. However, the skin is not in existence now, and even my notes of the time have been lost or destroyed. I really think I was justified in calling the bird the Dunlin."

Dr. Tufts is a careful observer, but as very unfortunately his speciman is not available for reference, the record must stand as one which was probably correct, but which cannot now be absolutely verified.

CURLEW SANDPIPER. *Erolia ferruginea* (Brünn.). A.O.U. No. 244.—This is an Old World species which occurs casually in North and South America, being recorded from Alaska, Ontario, Nova Scotia, Maine, Massachusetts, New York, New Jersey, and the West Indies and Patagonia. It is said to breed on the Arctic coast of Siberia, and a set of eggs, supposed to be of this species, has been taken in Greenland, where the bird is said to occur. Little, however, is definitely known on these points. Gilpin ("Shore Birds of Nova Scotia," *Trans. N. S. Inst. Nat. Sc.*, v, 383), under the old name *Tringa subarquata*, says he had it noted as taken at Halifax, October, 1864, "but," he adds, "I am not certain."*

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*Gilpin's statement is slightly ambiguous on one point. The paragraph from which the above quotation is made, says, "The Cape Curlew I have noted Halifax, October. *Tringa subarquata*, Schinss sand piper, I note Halifax, October 1864, but I am not certain." Now Schinz's Sandpiper is one of the names of the White-rumped Sandpiper (*Pisobia fuscicollis*) and is not, I believe, applied to *E. ferruginea*. In his list on page 385, he gives "*Tringa subarquata*—Curlew Sandpiper," but not the White-rumped (Schinz's) Sandpiper (*P. fuscicollis*); and on the next page he says, "I have not mentioned in this list Schinze's Sandpiper, although my notes give him at Halifax, August, 1864. I have no distinct recollection of the bird, or of seeing Dunlin's an enlarged copy of it, in Nova Scotia."

It is included in his list in the latter part of that paper (p. 385). Downs speaks of it as very rare, and says he purchased one in the Halifax market ("Catalogue of Birds of N. S.", *Trans. N. S. I. N. S.*, vii, 154).

GREEN SANDPIPER. *Helodromas ochropus* (Linn.). A. O.U. No. 257.—The normal habitat of this species, which is the Old World representative of our Solitary Sandpiper, is the northern portions of the Eastern Hemisphere from the Arctic regions to the Cape of Good Hope, and from the British Isles to China. It breeds in Scandinavia, Russia and Siberia, south to Turkestan. D. G. Elliot, formerly president of the American Ornithologists Union, in his *North American Shore Birds*,1895, p. 127, says "no record is obtainable that this bird has ever been seen alive in North America," and adds that it "is included in our fauna on the strength of a dealer in England having received a skin among a number of American birds from Halifax, Nova Scotia." This, he thinks is but negative evidence, and hardly of that satisfactory kind as to warrant the adoption of the species into the American fauna.

An individual of this species exists among a collection of birds from the Northwest Territories sent to the British Museum by the Hudson Bay Company; and Pennant says he also observed it among birds collected by Mr. Kuckan in North America (Richardson, quoted in Macoun's *Cat. of Canadian Birds*, 1909, p. 192). The A. O. U. *Check-list of N. A. Birds*, 1895, p. 94, notes it as "accidental in Nova Scotia," and Chapman's *Birds of Eastern North America*, 1912, p. 258, admits it as having been "twice recorded from America (Nova Scotia and Hudson Bay, Coues, *Auk*, xiv, 1897, 210);" and other writers mention this species in the same way. (See also *Bull. Nuttall Club*, iii, 1878, p. 49; and *The Auk*, xiv, 1897, p. 210.) If the Nova Scotian record is based, as no doubt it is, on the skin referred to by Elliot,

it must be slightly open to question in the minds of many ornithologists.

Ruff. *Machetes pugnax* (Linn.). A. O. U. No. 260.—On 27th May, 1892, a young ruffless male of this species was shot at Cole Harbour, near Halifax, N. S., and was mounted by T. J. Egan. It was identified by the Smithsonian Institution, Washington, as above-mentioned, although some United States ornithologists considered it differed slightly in some points from the European bird, but these, I believe, were insufficient to make any real doubt as to the determination, and the record must be taken as correct.* (See fuller account in Piers's "Notes on N. S. Zoology, No. 3," *Trans. N. S. Inst. Sc.*, viii, 1894, p. 402). It is the only occurrence of the species in Nova Scotia. It has occurred as a straggler on the Bay of Fundy coast of New Brunswick (*vide* M. Chamberlain), and one was killed on Toronto Island, Ontario, in the spring of 1882 (McIlwraith, *Birds of Ontario*, 1894, p. 154).

The Ruff is an Old World species, breeding from the Arctic coast south to Great Britain, Holland, Russia and Siberia; and winters throughout Africa, India, and Burma. It strays in spring and fall to the Western Hemisphere from Ontario and Greenland south to Indiana, North Carolina, Barbados, and northern South America, there being some fourteen records for the Atlantic coast. American records are given by T. S. Palmer, in *The Auk*, xxiii, 1906, p. 98.

Whimbrel. *Numenius phæpus* (Linn.). A. O. U. No. 267.—This Old World species has once been recorded as taken about 170 miles to the eastward of the Nova Scotian coast. On 23rd May, 1906, a female Whimbrel came aboard the steamship "Bostonian" when she was westward-bound and

*The original specimen, I think, is now in the collection of William Brewster, of Cambridge, Mass., or of Mr. Boardman, and if not, must have been lost in the fire which destroyed T. J. Egan's collection in September, 1904.

almost sixty miles to the southward of Sable Island, N. S., in latitude about 43° north and longitude 60° west. It died a short time before the steamer reached Boston. Mr. William Brewster of Cambridge, Mass., got the skin in October, 1907, and it is now in his collection, there being no doubt about the identification. (*Vide* letter of Mr. Brewster to writer, and his notes in *The Auk*).

The species is a native of the Eastern Hemisphere, and a fair number of specimens have been taken in Greenland, where it is possible it may occasionally breed, although no instance is known of its having done so. It is known to breed in Iceland, Shetland Isles, Scandinavia and Russia. The Nova Scotian record is the only one of its occurrence in North America south of Greenland.

LAPWING. *Vanellus vanellus* (Linn.). A. O. U. No. 269. —Two specimens of this bird have been taken here. The first was one found dead on the shore at Ketch Harbour, eleven miles south of Halifax, N. S., on 17th March, 1897, and was mounted by T. J. Egan. It was very thin and had, no doubt, died from starvation. This was the first record of the species' occurrence in this province. (See Piers, "Notes on N. S. Zoology: No. 4," *Trans. N. S. Inst. Sc.*, ix, 1897, p. 258). The only previous record for eastern North America south of Greenland was founded on a specimen taken at Merrick, Long Island, U. S. A., in December, 1883 (*vide* Dutcher, *The Auk*, iii, 1886, p. 438).

A second Nova Scotian specimen was shot at Upper Prospect, fifteen miles southwest of Halifax, on 12th December, 1905, by a man of that place. It is now in the Provincial Museum of Nova Scotia, accession no. 2954, having been purchased from T. J. Egan, who mounted it, in January, 1906. (Vide *Report of Provincial Museum of N. S. for 1906*, p. 8). It is interesting to note that a Lapwing was also taken at St. John's, Newfoundland, on 27th November, 1905, which

must have come southward at the same time as the Nova Scotian specimen. (Vide *The Auk*, xxiii, 221).

The Lapwing inhabits the northern parts of the Eastern Hemisphere, breeding from Central Eruope and Asia, north to the Arctic circle in Europe and latitude 55° north in Siberia; and has twice been found in Greenland (in 1820 and 1847), and has also been reported doubtfully from Norton Sound, Alaska, where Dall mentions the capture of what he supposed to be this species, although he did not himself see the specimen.

European Bird Incorrectly Reported as Occurring in Nova Scotia.

GREENLAND WHEATEAR. *Saxicola œnanthe leucorhoa* (Gmel.). A. O. U. No. 765a.—In conclusion some particulars will be given regarding the Greenland Wheatear, a bird long reported to have been taken in Nova Scotia, and is so mentioned in most books. About the year 1854, or shortly before, J. Cassin obtained a Wheatear skin which had been collected and sent to him by a gentleman from Nova Scotia, and he, not unnaturally, concluded that it had been taken in that province, and so mentioned it as a Nova Scotian occurrence in his *Illustrations of the Birds of California, etc.*, 1st series, no. vii, 1854, p. 208. Nova Scotia until very recently was thus given as a locality for its casual occurrence, for example in the A. O. U. *Check List* of 1895, Chapman's *Birds of Eastern North America*, 1895, etc. According, however, to Brewer in his *History of North American Birds*, i, 1874, p. 60, Cassin's specimen came in reality from Coal Harbour, Labrador, and not from Nova Scotia at all, although the gentleman who collected it was from that province. (See also Stejneger, "Wheatears of North America," *Proc. U. S. Nat. Mus.*, xxiii, 1901, pp. 473 and 479). The most recent works have now dropped Nova Scotia from the localities where it has

occurred, and we can no longer, therefore, consider it as a bird found here, although it is quite likely to be taken as an accidental visitor at any time. The occurrence of the Wheatear in North America at all, was formerly thought to be only accidental or occasional, but the bird has since been ascertained to be a regular breeder in our northern regions, although nowhere appearing as a regular migrant on this continent.

In 1901, Stejneger (*loc. cit.*) separated the form which breeds in northeast boreal America, under the subspecific name *Saxicola œnanthe leucorhoa* (Gmel.), the Greenland Wheatear, A. O. U. No. 765a, recognizing the typical Wheatear, *S. œnanthe œnanthe* (Linn.), A. O. U. No. 765, as the form which occurs in the northwestern part of North America as well as in the Eastern Hemisphere. The Greenland Wheatear (the form which might be found accidentally in our own province) breeds regularly in the Arctic zone of North America, from Ellesmere Land and Boothia Peninsula, east to Greenland and Iceland, and south to northern Ungava, even possibly in part of Quebec. It migrates through the British Isles and France, and winters in western Africa. Chapman (*Birds of Eastern North America*, 1912, p. 499,) says it is "casual in migration to Keewatin, Ontario, New Brunswick [is "N. B." a typographical error for the old "N. S.," Nova Scotia, of his earlier edition?], Quebec, New York, Bermuda, Louisiana and Cuba." Should this sub-species ever occur here, it must now be considered merely as a casual occurrence of a true North American bird.

Curious Lightning Freak.—By Watson L. Bishop, Dartmouth, N. S.

Read, 9th December, 1912.

On July 26th, 1903, a report came to me that our main twelve-inch water-pipe of cast iron, supplying the town of Dartmouth, Nova Scotia, with water, had burst and that a large quantity of water was flowing from the break. At this place, about two miles from the town and one from the reservoir lakes, where the pressure would be about twenty-five pounds per square inch, the pipe-line was carried east and west, five feet deep, along an old road, the side of which was lined by a low rough stone wall. Several larch (hackmatack) trees were growing along this wall, some through its centre and others close along the sides. The pipe-line here is six feet from the wall.

On examination I found that one of these trees growing in the side of the wall had been shattered by lightning. The stump (or what remained of it) was three to four feet high, and was split in several pieces with the top ends well apart, showing that the great pressure was from the centre outward. The trunk of the tree, which was about ten inches in diameter, was shattered for a length of fifteen feet or more, and was scattered over a radius of about one hundred feet from the stump.

The remainder or top of the tree was left intact and fell vertically until the largest end was about six feet from the ground. In this position it was held by the branches of the other trees growing near by. The lower end was six inches in diameter and a stone weighing about twelve pounds was found firmly held in a cleft in this end, and appeared to have been driven by the lightning up through the centre of the

tree until the force was spent, leaving the stone in the split as in a vice. The body of the trunk was so completely shattered into slivers that it took two men nearly half a day to collect the fragments from the unmowed hay-field on the other side of the wall.

The water-pipe was broken at a point nearest the shattered tree, nine feet distant. When the broken pipe was taken out it was found to be strongly magnetic. So strong is the magnetism even at the present time (December, 1912, nine years afterwards), that a handful of nails held to it will be drawn quite firmly to the edges of the break. A piece of steel rubbed a few times on this piece of pipe becomes so strongly magnetized as to pick up pieces of iron. The opposite ends of the break have opposite polarities as demonstrated by the magnetic compass and steel magnets.

The inference is that the electric current burst from the pipe-line to the tree, and on leaving the pipe broke it, and on entering the tree at its roots carried the stone up through the bursting trunk until, the force being spent, it remained in the split of the unshattered top.

Note on a Gastrolith found in a Moose.—By Professor D. Fraser Harris, M. D., C. M., D. Sc., F. R. S. E., Dalhousie University, Halifax.

Read, 20th January, 1913.

On first October, 1905, a large bull moose (*Alces Amercanus*), eight or nine years old, and weighing 850 pounds was shot by Lieut. L. G. Matterson, R. A., at Ship Harbour, Long Lake, about ten miles south-east of Middle Musquodoboit, Halifax county, N. S. The guide, William H. Day, on opening the animal, found a hard oval concretion in its stomach. This was given to Mr. John W. Willis of Halifax, who possesses the mounted head of the animal. In May, 1912, Mr. Willis presented the calculus to the Provincial Museum (accession No. 3785). Mr. Piers asked me to examine the concretion and report on its chemical constitution. On cutting the calculus open carefully with a fret saw, I found it was a laminated concretion of oval section which now measured 1.90 inches in length (the end having broken off). The original length had doubtless been about 2.40 inches. The diameter of the section is 1.50 inches; and the thickness 1.15 inches. There are about seven concentric layers, every alternate one being somewhat more pronounced and more easily separated. In its centre was embedded a flat, smooth piece of slate not fully exposed in the section, but measuring 0.85 of an inch where it was exposed.

On submitting a fragment of the outer shell to chemical investigation, the substance proved to be calcium orthophosphate, with no obvious admixture of organic matter. According to the statement made by Mr. Day, communicated by Mr. Willis, the calculus was found in the stomach

and not in intestine or bladder; it is, therefore, a gastrolith. Mr. Day states that he has known of a tooth being the centre of a similar concretion in the moose's stomach. Captain (now General) Campbell Hardy, R. A., in an unpublished paper entitled "Notes on the History of the Moose," read before this Institute on 7th May, 1867, exhibited and spoke of calculi formed in the stomach of that animal. The interest of this case is that the nucleus of crystallisation is a stone and not organic matter such as has so frequently been found in the "hair-balls" in horses and cows.

Notes on a Granite Contact Zone, Near Halifax, N. S.

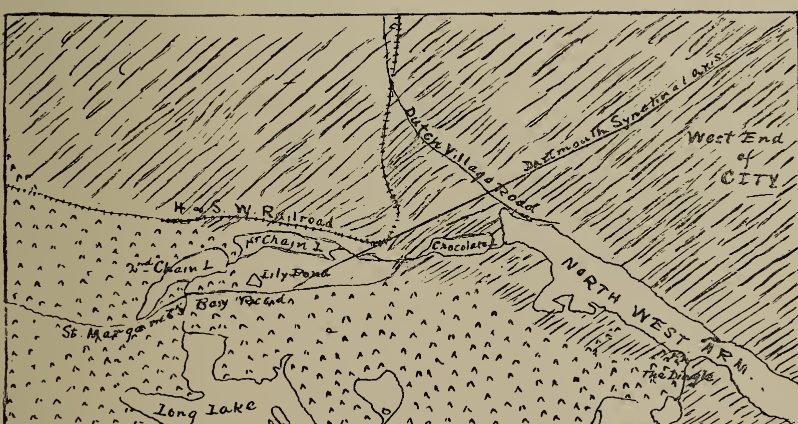
By Prof. D. S. McIntosh, M. Sc., Dalhousie College, Halifax, N. S.

Read May 12th, 1913.

A "Quebec and Maritime Provinces" excursion forms part of the programme of the Twelfth International Geological Congress which meets in Toronto in August of this year. According to the first planned arrangement, the party when at Halifax was to have visited a contact zone of the granite and slate in the vicinity of Chocolate Lake. Owing, however, to a change in the date of meeting of the Congress and some re-arrangement of itineraries, the party reaches Halifax on Sunday morning and departs early the following day. The proposed trip to this interesting locality was consequently abandoned. But while it was in contemplation some preparation was made for it. Dr. Young, who has charge of the excursion, together with Mr. Faribault and the writer of this paper, examined the rock of the district and procured specimens wherever there was any noticeable difference of texture or mineral constituents. From these specimens a series of microscopic sections were made. These thin sections the Geological Survey very kindly placed at the disposal of the writer for the preparation of this paper.

The granite batholith which forms the bed-rock of a large portion of the western part of the Province meets the metamorphosed sedimentary rock close to the southwestern shore of the North West Arm. The boundary line is irregular. Running in a general northwesterly direction from the Dingle, it passes south of Chocolate Lake, follows pretty closely the main road to Lily Pond, bends around between First and Second Chain Lakes, and thence has a westerly direction

until it crosses the Halifax and Southwestern railway and turns north. The granite is an intrusive of probably Devonian age. It evidently cooled and solidified under a great thickness of pre-existing rock, which has since been largely eroded. In the granite are found patches of darker, finer-grained material, which is probably the remains of blocks of the older rock partially assimilated. The effect of the high temperature of the intrusive magma produced a marked change in the overlying and surrounding rock masses. This change consisted largely in the development of new minerals out of some of the original constituents of the rock. As far as surface observations go, for upwards of a mile from the contact the influence of the heat was felt. A belt or zone of metamorphosed rock thus surrounds the igneous mass. Where the intruded rock varied in composition, the resultant metamorhpism differed somewhat. Of this contact zone the part more directly under discussion lies to the northwest of Chocolate Lake. (See map). In the northern and eastern



Map, showing Contact Zone — Granite · Slate,
Sketched from C.G.S sheet N- '019. Scale: 1 mile = 1 inch.

section of this area, is the intruded rock, a black slate with a general easterly-westerly strike, and a south dip of 65° in the north which gradually decreases as the trough of the Dartmouth Synclinal is approached.

The original mineral composition of the slate beds varied somewhat. This is evident in the difference now seen in the rock; some are carbonaceous, others siliceous, while almost all the rock contains pyrite in varying proportions. This slate forms a part of the Upper Division of the Gold-Bearing series. The Halifax and South Western railroad passes through the area, and the numerous cuttings afforded means of easily obtaining material for examination. Samples of the slate were taken at intervals along the railroad from the point where it crosses the Dutch Village Road up to the contact with the igneous rock. Within this belt, metamorphism is excellently well shown. Even at the edge of the area, the furthest point from the nearest surface contact, metamorphic alteration is evidenced by the spotted appearance of the slate. Beyond this, doubtless, the rock is also altered, the zone being wider than the extent studied. Additional work could be done in tracing the result of the metamorphism from this point back into the unaltered slate. All through the contact zone the slate has a spotted appearance easily recognized, while as the granite is neared, long slender well-formed crystals are seen in the rock. The presence of these crystals from the cleavage faces of which the light is reflected, serves easily to distinguish it from the less altered spotted slate.

Microscopic examinations of the sections reveal a marked similarity between this granite contact and those more or less celebrated ones described from the Barr-Andlau of the Vosges Mountains, the Lake District of England, and elsewhere. The "base" of the slate, which is fine textured, is composed of sericite, minute grains of quartz and feldspars, graphite and other black carbonaceous particles. Probably very little, if any, of the original detrital material is present,

FIGURES × 62.

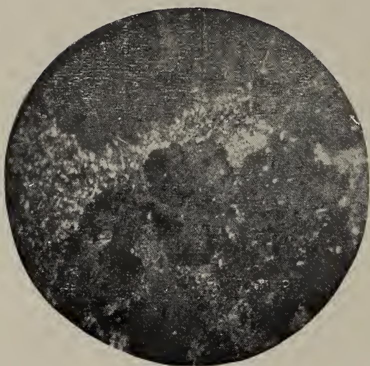


Fig. 1.—Cordierite slate (*crossed nicols*).

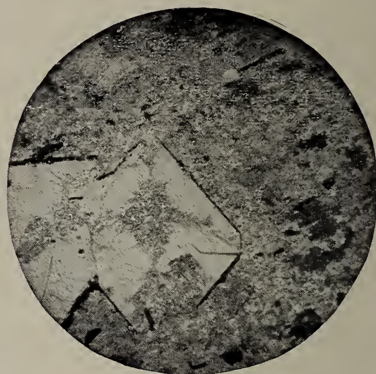


Fig. 2.—Andalusite—cordierite slate.

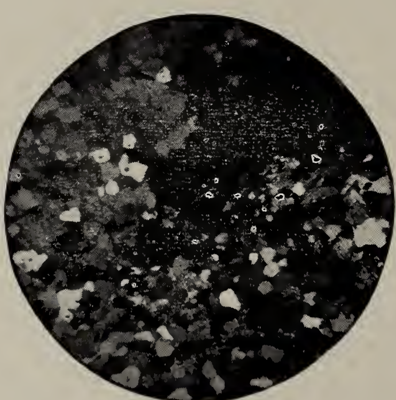


Fig. 3.—Siliceous slate (with pyrite) (*crossed nicols*).

Fig. 4.—Granite (*crossed nicols*).

the minerals enumerated above being largely recrystallisation products. Originally, the rock was probably a carbonaceous clay slate or shale. The grains and shreds all lie for the most part with their long axis in the same direction—that of the slaty cleavage. The re-crystallization is doubtless the result of pressure through a long period of time, and is itself the cause of the cleavage, normal to the pressure. This occured during the long time in which the folding was going on, which is evidenced in the present attitude of the rock and was prior to the intrusion of the granite. The proportion of the minerals of the "base" varies in the sections examined, in some sericite is more abundant, in others quartz, while in others there is more carbonaceous material. This difference is probably due to constituent varieties of the original beds. Pyrite is abundant in some laminae, in others almost absent.

Recrystallisation was probably completed before the contact metamorphism began. The first change brought about by the granitic intrusion was likely the production of a clear, brownish biotite in shreds and irregular crystals. Cleavage lines are rarely pronounced and inclusions are rare. Associated, and sometimes intergrown with it, is a colourless, slightly pleochroic mineral with rather high refraction, probably phlogopite. The biotite flakes are set at various angles to the cleavage planes and were, therefore, not affected by the pressure. It also occurs as inclusions in minerals to be described further on, which fixes its position in the time scale of metamorphism.

The spots so characteristic of the slate are found to be fibrous, ovoid and irregular patches of partially decomposed cordierite (Fig. 1). Unaltered portions occur at and about the centre of the patch, while the edges consist of a yellowish chloritic substance. The refractive index and double refraction are low. A faint bluish pleochroism is observable in one or two places. The crystal outline, which can be seen only between crossed nicols is mostly prismatic with occasionally

the characteristic pseudo-hexagonal form and twinning in segments and in included laminae. Irregular lenticular forms also occur. In the cordierite are inclusions of carbon, biotite, and quartz. These are remnants of the minerals which furnished the material for the formation of the cordierite and are consequently older than the containing mineral. The inclusions are arranged in lines parallel to the cleavage of the slate showing that the cordierite was formed after the cleavage and was not influenced by the pressure.

Within the area extending from the edge of the granite into the contact zone for a few hundred yards is the rock already referred to as being distinctive on account of the well developed crystals that appear in it. Here the influence of the hot granitic mass was most intense, and hence the metamorphism most pronounced. In the rock in this part of the belt are found the minerals already described as occurring in the other part, and in addition, fine andalusite crystals (Fig.2). These last occur as clear prism forms with prismatic cleavage. Where wedge shaped outlines are found, the extinction is in the direction of the wedge length, from edge to edge of the prism. The refraction is higher than that of the cordierite, the double refraction low. In an occasional spot on a crystal, the characteristic rose-red pleochroism is seen. Portions of some of the crystals are clouded with inclusions, while other parts are quite clear. All the other minerals of the rock form inclusions in the andalusite, so that it appears to have been the last to form. Its variety, chiastolite, occurs quite often in the slides. The carbonaceous inclusions are arranged in the cross section of the prism diagonally, the bulk of it occupying the corners of the prism, paralleling in a rough way the extinction of the crystal.

The only contact metamorphism noticed in the siliceous beds is the production of a few flakes of mica with perhaps a trace of scapolite and sillimanite (Fig. 3). A crystal of andalusite occurs in a slide from a small granite dyke that

extends into the slate. This doubtless resulted from the absorption of some of the slaty material, although no further evidence of such was found.

There is no evidence of any gases or vapours from the molten granite having been a factor in the alteration of the slate of the area studied.

Something like the following would be a sequence of events for this area. In Pre-Cambrian time, fine sediment containing a good deal of carbonaceous material was deposited in the water some distance off shore, on a slowly subsiding sea-bottom. This became consolidated into a carbonaceous shale. Pressure set in from the direction of the Atlantic seaboard, and continuing through long periods of time threw the great thickness of rock into high folds. The pressure converted the shale into a slate. Then in Devonian time came the intrusion of the granite, the heat from which changed the slate within the sphere of its influence into a cordierite-slate, and near the contact, where the alteration was greatest, into an andalusite-cordierite slate. During parts of the long periods that have elapsed since then, as well as in previous periods, erosion processes have been at work, resulting in the present day aspect of the area.

The Phenology of Nova Scotia, 1912.—By A. H. MacKay, Ll. D.

(Read by title, 12 May, 1913.)

These phenological observations were made in the schools of the province of Nova Scotia as a part of the Nature Study work prescribed. The pupils report or bring in the flowering or other specimens to the teachers when they are first observed. The teachers record the first observation and observer, and vouch for the accurate naming of the species. The schedules from 200 of the best schools form the material of the following system of average dates (phenochrons) for the ten biological regions of the Province, and the phenochrons of the Province as a whole. The compilation of the 200 schedules was done by Walter M. Billman, M. A.

Regional phenochrons starred (*) are from supernumerary schedules which are not included in the general compilation, and thus do not affect the more general phenochrons. The nomenclature followed is that of Spotton or Gray.

THE PHENOLOGY OF NOVA SCOTIA, 1912.

[Compiled from over 200 local observation schedules.]

Year 1912.

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When First Seen. Observation Regions.

	1. Yarmouth and Digby	2. Shelburne, Queens and Lunenburg	3. Annapolis and Kings	4. Hants and South Colchester	5. Halifax and Guysboro	6. S. Cobequid Slope, (S. Cum. & Col.)	7. N. Cumb, Col, Pictou and Antigonish	8. Richmond and Cape Breton	9. Bras d'Or Slope, Inv. and Victoria / 10. Inverness Slope to Gulf	Average Dates
1 Alnus incana, Wild	106	104	107	112	111	106	107	114	114	109.0
2 Populus tremuloides	125	111	120	120	124	122	117	122	127	120.9
3 Epigea repens, L.	96	101	102	108	107	110	111	117	118	107.8
4 Equisetum arvense	129	119	123	126	136	129	131	133	131	128.6
5 Sanguinaria Canadensis	....	....	134	124	126	....	127	....	154	133.0
6 Viola Blanda	120	121	123	126	127	123	130	132	132	126.0
7 Viola palmata, *cucullata*	123	126	126	128	130	126	131	136	134	128.9
8 Hepatica triloba, etc.	....	124	140	126	132	....	....	142	....	132.8
9 Acer rubrum	138	124	125	130	133	129	129	135	134	130.8
10 Fragaria Virginiana	127	122	121	125	129	126	129	133	134	127.3
11 " " fruit ripe	160	160	158	163	164	162	161	168	168	162.7
12 Taraxacum officinale	128	124	125	131	132	131	133	139	135	130.9
13 Erythronium Americanum	143	136	144	131	....	130	135	151	150	124.4
14 Coptis trifolia	130	132	134	134	134	136	134	138	135	134.1
15 Claytonia Caroliniana	....	....	132	128	125	132	130	139	136	131.7
16 Nepeta Glechoma	142	135	131	135	140	136	146	144	143	139.1
17 Amelanchier Canadensis	142	137	134	136	142	139	137	146	148	140.1

When Becoming Common. Observation Regions.

	Average Dates.	1. Yarmouth and Digby	2. Shelburne, Queens and Lunenburg	3. Annapolis and Kings	4. Hants and South Colchester	5. Halifax and Guysboro	6. S. Cobequid Slope, (S.Cum. & Col.)	7. N.Cumb, Col, Pictou and Antigonish	8 Richmond and Cape Breton	9. Bras d'Or Slope, Inv. and Victoria / 10. Inverness Slope to Gulf
1 Alnus incana, Wild	116.8	118	110	115	119	120	114	113	120	122
2 Populus tremuloides	128.5	133	118	126	134	131	132	126	127	130
3 Epigea repens, L.	116.1	107	110	111	116	117	116	118	124	126
4 Equisetum arvense	134.3	138	125	129	132	146	130	136	138	135
5 Sanguinaria Canadensis	138.2	....	....	142	127	133	....	133	....	156
6 Viola Blanda	132.2	131	127	130	131	133	130	134	136	138
7 Viola palmata, *cucullata*	134.8	132	132	131	133	137	132	136	141	139
8 Hepatica triloba, etc.	138.6	....	130	146	130	138	....	....	149	....
9 Acer rubrum	136.5	143	130	132	135	138	138	134	139	140
10 Fragaria Virginiana	136.0	134	131	131	134	137	135	137	140	145
11 " " fruit ripe	172.4	173	168	168	172	174	171	172	176	176
12 Taraxacum officinale	139.0	135	131	132	137	137	138	138	144	141
13 Erythronium Americanum	144.6	....	142	150	134	....	135	141	156	154
14 Coptis trifolia	140.1	140	136	141	140	139	142	139	143	141
15 Claytonia Caroliniana	137.0	....	....	137	133	130	137	134	145	143
16 Nepeta Glechoma	146.1	162	140	138	139	145	142	150	150	149
17 Amelanchier Canadensis	144.8	145	141	140	141	148	145	141	151	151

THE PHENOLOGY OF NOVA SCOTIA, 1912.—*Continued.*

Year 1912.

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When First Seen. Observation Regions.

No.	Species	1. Yarmouth and Digby	2. Shelburne, Queens and Lunenburg	3. Annapolis and Kings	4. Hants and South Colchester	5. Halifax and Guysboro	6. S. Cobequid Slope, (S.Cum.&Col.)	7. N.Cumb, Col, Pictou and Antigonish	8. Richmond and Cape Breton	9. Bras d'Or Slope, Inv. and Victoria / 10. Inverness Slope to Gulf	Average Dates
18	Amelanchier Canadensis fruit ripe	....	....	180	....	180	....	203	240	....	200.7
19	Prunus Pennsylvanica	144	141	136	141	146	144	141	150	150	143.7
20	" " fruit ripe	....	195	196	....	....	200	192	240	....	204.6
21	Vaccinium Can. and Penn.	136	136	138	143	142	142	142	152	155	142.9
22	" " fruit ripe	192	190	163	....	....	220	190	220	....	194.4
23	Rannuculus acris	155	146	146	150	148	151	151	156	151	150.4
24	R. repens	155	151	150	154	160	156	155	161	155	155.2
25	Trillium erythrocarpum	149	142	137	144	144	139	142	151	151	144.3
26	Rhododendron Rhodora	145	142	144	145	149	144	148	153	144	146.0
27	Cornus Canadensis	153	147	143	149	152	148	145	156	153	149.6
28	" " fruit ripe	*141	193	212	*147	*145	....	....	*159	....	202.5
29	Trientalis Americana	150	146	145	147	149	146	146	153	151	148.1
30	Clintonia borealis	151	151	146	154	154	152	152	156	154	152.2
31	Calla palustris	....	150	151	149	154	166	160	162	170	157.7
32	Cypripedium acaule	155	152	148	157	157	156	159	165	162	156.8
33	Sisyrinchium angustifol	161	155	151	154	160	157	157	163	165	158.1
34	Linnaea borealis	165	160	158	167	164	164	167	170	174	165.4
35	Kalmia glauca	160	151	153	152	150	148	150	157	165	154.0
36	Kalmia augustifolia	168	165	162	161	160	148	156	160	165	160.6
37	Cratægus oxyacantha	164	153	154	153	158	147	157	167	168	157.9
38	Cratægus coccinea, etc	170	158	151	156	156	160	156	164	160	159.0
39	Iris versicolor	162	160	157	166	169	163	165	171	172	167.3
40	Chrysanthemum Leucanth	161	158	156	157	165	162	159	170	167	150.6
41	Nuphar advena	159	160	163	162	164	161	161	171	170	163.4
42	Rubus strigosus	163	158	152	151	161	150	159	164	158	157.3

When Becoming Common. Observation Regions.

No.	Species	Average Dates	1. Yarmouth and Digby	2. Shelburne, Queens and Lunenburg	3. Annapolis and Kings	4. Hants and South Colchester	5. Halifax and Guysboro	6. S. Cobequid Slope, (S. Cum & Col.)	7. N.Cumb, Col, Pictou and Antigonish	8. Richmond and Cape Breton	9. Bras d'Or Slope, Inv. and Victoria / 10. Inverness Slope to Gulf
18	Amelanchier Canadensis fruit ripe	227.5	....	....	....	....	....	....	209	246	....
19	Prunus Pennsylvanica	148.8	152	147	141	146	151	149	145	154	154
20	" " fruit ripe	213.0	....	208	212	....	....	204	197	244	....
21	Vaccinium Can. and Penn.	150.0	145	142	146	148	153	150	147	157	162
22	" " fruit ripe	211.2	....	215	181	....	....	225	....	224	....
23	Rannuculus acris	157.8	162	152	155	157	160	157	157	161	159
24	R. repens	161.1	164	158	154	160	164	161	162	167	160
25	Trillium erythrocarpum	148.8	154	147	142	147	148	143	146	156	156
26	Rhododendron Rhodora	151.7	154	148	152	150	154	149	152	158	148
27	Cornus Canadensis	155.8	159	152	151	154	157	156	154	161	158
28	" " fruit ripe	222.0	*144	....	222	*153	*155	....	....	*165	....
29	Trientalis Americana	153.6	158	152	151	152	155	152	150	157	155
30	Clintonia borealis	157.6	159	154	151	161	161	156	157	160	159
31	Calla palustris	163.5	....	155	159	157	161	171	165	167	173
32	Cypripedium acaule	161.5	161	158	155	163	161	159	164	166	166
33	Sisyrinchium angustifol	164.3	166	161	157	160	174	160	162	168	171
34	Linnaea borealis	170.9	171	165	164	172	170	171	172	176	177
35	Kalmia glauca	157.7	169	156	158	156	159	153	154	161	153
36	Kalmia augustifolia	164.4	171	170	167	165	169	154	162	164	158
37	Cratægus oxyacantha	164.2	174	159	164	160	162	154	161	170	174
38	Cratægus coccinea, etc	163.0	171	163	156	160	162	162	158	170	165
39	Iris versicolor	170.0	171	165	163	171	171	169	171	175	174
40	Chrysanthemum Leucanth	157.7	169	165	163	166	172	168	167	174	175
41	Nuphar advena	168.9	169	168	169	165	170	158	168	175	178
42	Rubus strigosus	164.9	177	164	158	159	168	160	165	170	163

....	203	180	....	*160	....	203	225	....	202.7	43 Rubus strigosus fruit ripe	212.7	....	217	196	....	*164	....	207	231	....
166	167	172	162	162	158	172	176	181	169.6	44 Rhinanthus Crista-galli	175.6	175	172	179	174	177	163	177	179	184
164	164	149	164	169	168	166	170	169	164.8	45 Rubus villosus	171.9	175	169	167	169	174	172	172	176	173
....	....	193	....	....	....	228	250	....	223.7	46 " " fruit ripe	234.5	....	....	213	....	....	....	....	256	....
169	163	157	....	172	....	171	170	176	168.3	47 Sarracenia purpurea	173.1	176	167	162	....	177	....	176	175	179
163	167	163	161	168	....	174	172	....	166.9	48 Brunella vulgaris	173.6	174	170	167	174	175	....	179	176	....
177	173	169	174	166	175	171	181	....	173.7	49 Rosa lucida	181.7	189	179	172	180	175	183	176	200	....
171	162	164	163	166	167	169	170	174	167.3	50 Leontodon autumnale	173.1	182	168	169	170	170	175	172	177	175
167	159	167	161	....	....	176	175	....	167.5	51 Linaria vulgaris	172.6	....	161	172	172	....	....	181	177	....
138	135	131	132	136	136	133	141	138	137.1	52 Trees appear green	147.0	150	144	140	143	163	144	142	150	147
144	136	136	140	144	141	140	150	147	142.0	53 Ribes rubrum (cultivated)	147.7	152	141	143	143	151	149	145	155	150
182	193	172	141	178	198	179	216	....	189.7	54 " " (fruit ripe)	203.0	....	217	180	148	....	206	192	220	....
144	138	136	141	148	143	143	152	155	144.4	55 R. nigrum (cultivated)	150.3	154	144	143	146	153	150	147	159	157
....	190	....	....	....	....	206	220	....	203.3	56 " " (fruit ripe)	214.7	....	209	....	....	....	....	209	226	....
150	144	137	143	146	145	144	153	152	146.0	57 Prunus Cerasus	151.1	156	147	142	149	155	151	148	157	155
....	....	178	....	....	....	....	250	....	214.0	58 " " fruit ripe	....	....	....	*181	....	....	....	....	....	....
148	144	139	145	149	143	144	154	152	146.4	59 Prunus domestica	150.7	154	149	144	149	155	145	149	157	154
150	147	141	146	152	148	147	155	153	148.8	60 Pyrus Malus	154.5	159	152	149	151	159	154	151	159	157
158	153	149	153	160	156	152	161	159	155.7	61 Syringa vulgaris	161.7	165	157	155	157	174	163	156	167	161
157	157	155	154	159	162	159	160	162	158.3	62 Trifolium repens	167.2	161	164	160	163	166	171	166	166	166
148	152	150	153	158	160	159	164	165	156.8	63 Trifolium pratense	164.7	159	160	158	163	167	169	167	168	171
158	166	158	165	155	157	163	169	....	161.4	64 Phleum pratense	166.7	175	165	164	....	159	165	167	173	....
180	179	180	175	....	....	178	189	....	180.2	65 Solanum tuberosum	190.7	182	187	....	....	....	....	193	201	....
111	113	114	123	120	122	124	120	128	119.4	66 Ploughing (first of season)	128.3	118	125	124	131	130	133	133	128	133
122	119	126	128	128	131	133	136	141	129.3	67 Sowing	137.3	127	124	136	135	140	140	144	143	147
127	118	129	133	130	135	136	125	135	129.8	68 Potato-planting	137.9	127	126	139	144	138	148	144	134	141
119	132	126	135	134	124	130	123	129	128.0	69 Sheep-shearing	139.8	131	141	138	146	143	141	144	140	134
180	176	174	180	....	207	217	208	212	195.5	70 Hay-cutting	205.8	181	190	191	....	....	232	224	217	....
238	231	237	245	246	236	237	239	232	237.9	71 Grain-cutting	245.0	....	240	241	250	255	242	244	243	....
250	252	246	262	258	272	267	272	275	262.7	72 Potato-digging	279.4	258	273	259	267	269	280	273	278	....
75	82	87	79	78	82	79	91	96	83.2	73a Opening of rivers	....	....	....	....	....	....	....	....	....	....
89	94	97	107	111	117	101	116	118	105.8	73b Opening of lakes	....	....	....	....	....	....	....	....	....	....
97	99	102	116	112	104	116	118	120	109.3	74a Last snow to whiten ground	....	....	....	....	....	....	....	....	....	....
120	114	112	121	121	116	119	127	125	119.4	74b " fly in air	....	....	....	....	....	....	....	....	....	....
128	120	126	139	134	122	135	141	127	130.2	75a Last spring frost—hard	....	....	....	....	....	....	....	....	....	....
159	148	151	160	139	134	156	155	149	150.1	75b " —hoar	....	....	....	....	....	....	....	....	....	....
92	75	90	78	126	84	72	130	122	96.5	76a Water in streams—high	....	....	....	....	....	....	....	....	....	....
240	242	226	....	181	....	185	172	....	207.5	76b " —low	....	....	....	....	....	....	....	....	....	....
257	258	253	254	265	248	254	269	285	260.3	77a First autumn frost—hoar	....	....	....	....	....	....	....	....	....	....
283	280	271	271	277	278	273	288	....	277.6	77b " —hard	....	....	....	....	....	....	....	....	....	....
286	297	281	281	284	303	280	271	302	287.2	78a First snow to fly in air	....	....	....	....	....	....	....	....	....	....
312	314	296	298	298	308	297	301	319	304.8	78b " whiten ground	....	....	....	....	....	....	....	....	....	....
350	356	335	....	291	355	315	330	....	333.1	79a Closing of lakes	....	....	....	....	....	....	....	....	....	....
6	6	345	355	....	358	329	338	....	352.7	79b " rivers	....	....	....	....	....	....	....	....	....	....
84	88	92	97	90	91	87	78	99	89.5	81a Wild ducks migrating, North	....	....	....	....	....	....	....	....	....	....
....	315	326	....	....	323	281	308	....	310.6	81b " " " South	....	....	....	....	....	....	....	....	....	....
94	85	87	91	79	91	88	81	94	87.8	82a " geese " North	....	....	....	....	....	....	....	....	....	....
....	312	317	....	....	325	283	270	....	301.4	82b " " " South	....	....	....	....	....	....	....	....	....	....

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96	94	93	99	93	101	99	97	103	97.2	83 Melospiza fasciata, North	....	....	....	....	....	....	....	....	....	....
83	85	84	89	85	84	91	96	98	88.3	84 Turdus migratorius "	....	....	....	....	....	....	....	....	....	....
90	89	109	92	85	95	93	91	125	96.5	85 Junco hiemalis "	....	....	....	....	....	....	....	....	....	....
....	123	148	132	134	112	131	129	135	130.5	86 Actitis macularia "	....	....	....	....	....	....	....	....	....	....
133	....	138	138	136	151	125	138	150	138.6	87 Sturnella magna "	....	....	....	....	....	....	....	....	....	....
117	122	133	128	120	122	126	121	120	123.2	98 Ceryle Alcyon "	....	....	....	....	....	....	....	....	....	....
128	125	136	....	130	131	127	131	128	129.5	89 Dendrœca coronata "	....	....	....	....	....	....	....	....	....	....
129	128	140	148	139	150	138	139	133	138.2	90 D. æstiva "	....	....	....	....	....	....	....	....	....	....
139	113	129	143	138	106	130	110	114	124.7	91 Zonotrichia alba "	....	....	....	....	....	....	....	....	....	....
144	142	141	143	148	143	144	157	147	145.4	92 Trochilus colubris "	....	....	....	....	....	....	....	....	....	....
131	135	135	136	137	139	133	153	119	135.3	93 Tyrannus Carolinensis, North	....	....	....	....	....	....	....	....	....	....
105	136	137	146	141	126	138	149	107	131.7	94 Dolychonyx oryzivorus "	....	....	....	....	....	....	....	....	....	....
120	136	141	150	148	....	133	154	153	141.9	95 Spinis tristis "	....	....	....	....	....	....	....	....	....	....
157	142	145	104	130	125	157	162	144	140.7	96 Setophaga ruticilla "	....	....	....	....	....	....	....	....	....	....
....	143	150	....	161	....	151	163	121	148.2	97 Ampelis cedrorum "	....	....	....	....	....	....	....	....	....	....
126	136	132	113	136	121	130	149	125	129.8	98 Chordeiles Virginianus "	....	....	....	....	....	....	....	....	....	....
99	98	101	105	111	112	104	115	121	107.3	99 First piping of frogs	....	....	....	....	....	....	....	....	....	....
112	103	112	110	112	121	122	121	125	115.3	100 First appearance, snakes	....	....	....	....	....	....	....	....	....	....

THUNDERSTORMS—PHENOLOGICAL OBSERVATIONS, NOVA SCOTIA, 1912.

The indices indicate the number of stations from which the Thunderstorms were reported on the day of the year specified.

OBSERVATION REGIONS.

1. Yarmouth and Digby.	2. Shelburne, Queens and Lunenburg.	3. Annapolis and Kings.	4. Hants and South Colchester.	5. Halifax and Guysboro.	6. S. Cobequid Slope (S. Cum. and Col.)	7. North Cum., Col., Pictou and Antig.	8. Richmond and Cape Breton.	9 & 10. Victoria and Inverness.	Total reports of Thunderstorms for Year 1912.
......	50	......	......	......	......	......	......	......	50
......	......	52	......	......	......	......	......	......	52
......	......	53	......	......	......	......	......	......	53
......	......	64	......	......	......	......	......	......	64
......	......	65	......	......	......	......	......	......	65
......	......	......	......	......	66	......	......	......	66
......	......	......	......	67	......	......	......	......	67
68	......	......	......	......	......	......	......	......	68
69^{3}	......	69^{4}	69^{2}	69	......	......	......	......	69^{10}
70^{3}	......	70^{2}	70^{2}	......	70	......	......	......	70^{8}
......	72	......	......	......	......	......	......	......	72
......	......	......	......	74	......	......	......	......	74
......	......	75	......	......	......	......	......	......	75
......	76^{2}	76	......	......	......	......	......	......	76^{3}
......	77	......	......	......	......	......	......	......	77
78	78^{12}	78	78	......	......	......	78	......	78^{16}
......	79^{33}	79^{3}	79	79^{2}	79^{3}	......	......	......	79^{42}
80	80	80^{4}	......	80^{7}	80^{4}	......	......	......	80^{17}
......	......	......	......	81	......	......	......	......	81
......	82	......	......	82	......	......	......	......	82^{2}
......	85^{3}	......	......	......	......	......	......	......	85^{3}
......	......	......	......	......	......	......	88	......	88
......	97	......	......	......	......	......	......	......	97
......	......	......	......	98	......	......	98		98^{2}
......	......	......	......	......	......	......	99	......	99
......	......	......	......	......	100	......	......	......	100
......	......	......	......	......	101	101	......	......	101^{2}
......	......	......	......	......	......	102	......	......	102
......	......	......	......	......	103	......	......	......	103
......	......	106	......	106^{2}	......	106	106	......	106^{5}
......	107	107^{6}	107	107	107^{4}	107^{14}	107^{12}	107	107^{40}
......	......	108^{2}	......	108^{2}	......	108^{4}	108^{10}	108^{3}	108^{21}
109^{2}	......	......	......	......	109	......	......	......	109^{3}
......	110^{2}	......	......	......	......	110	......	......	110^{5}
......	113^{2}	......	......	113	......	......	......	......	113^{3}
......	114	114	114	......	......	......	......	......	114^{3}
......	115^{31}	......	......	......	......	......	......	......	115^{31}
116	116^{5}	116^{2}	116	116	......	......	......	......	116^{10}
	117^{14}	......	......	......	......	117	117	......	117^{16}

THUNDERSTORMS—PHENOLOGICAL OBSERVATIONS, NOVA SCOTIA, 1912.

The indices indicate the number of stations from which the Thunderstorms were reported on the day of the year specified.

OBSERVATION REGIONS.

1. Yarmouth and Digby.	2. Shelburne, Queens and Lunenburg.	3. Annapolis and Kings.	4. Hants and South Colchester.	5. Halifax and Guysboro.	6. S. Cobequid Slope (S. Cum. and Col.)	7. North Cum., Col., Pictou and Antig.	8. Richmond and Cape Breton.	9 & 10. Victoria and Inverness.	Total reports of Thunderstorms for Year 1912.
118	118^{12}		118	118^{4}		118			118^{19}
	119^{3}	119^{2}		119^{2}		119^{3}			119^{10}
							123		123
				124					124
	125								125
	126					126			126^{2}
				127					127
						128			128
	129^{2}								129^{2}
	130^{14}			130^{2}		130^{2}	130		130^{19}
131^{2}	131^{2}	131^{3}	131	131^{8}	131	131^{5}	131^{3}	131^{5}	131^{30}
132			132	132^{2}		132	132		132^{6}
		133				133			133^{2}
	134								134
	135	135							135^{2}
						136			136
			137			137	137		137^{3}
						138^{2}			138^{2}
						139^{2}	139		139^{3}
	140^{7}		140^{3}		140	140^{11}		140^{2}	140^{24}
141							141		141^{2}
			142					142	142^{2}
				143			143		143^{2}
144^{3}	144^{24}	144^{3}	144^{4}	144^{4}	144^{2}	144^{11}	144^{2}	144	144^{54}
145^{4}	145^{8}	145^{15}	145^{7}	145^{8}	145^{10}	145^{16}	145^{15}	145^{2}	145^{85}
	146^{2}	146^{6}	146^{4}	146^{4}			146		146^{17}
		147							147
	148^{2}	148							148^{3}
		149							149
						150			150
151				151		151			151^{3}
		153				153	153^{2}		153^{4}
	154		154	154^{2}	154	154	154		154^{7}
		155^{3}	155^{10}	155^{5}	155^{10}	155^{14}	155^{5}	155^{5}	155^{52}
			156			156^{2}	156^{2}		156^{5}
	157			157	157				157^{3}
		158					158		158^{2}
						159^{2}			159^{2}
	160^{4}		160	160		160^{2}	160		160^{9}
	161^{2}	161^{3}	161	161	161	161^{10}	161	161	161^{20}

THUNDERSTORMS—PHENOLOGICAL OBSERVATIONS, N. S., 1912.—*Continued.*

The indices indicate the number of stations from which the Thunderstorms were reported on the day of the year specified.

OBSERVATION REGIONS.

1. Yarmouth and Digby.	2. Shelburne, Queens and Lunenburg.	3. Annapolis and Kings.	4. Hants and South Colchester.	5. Halifax and Guysboro.	6. S. Cobequid Slope (S. Cum. and Col.)	7. North Cum., Col., Pictou and Antig.	8. Richmond and Cape Breton.	9 & 10. Victoria and Inverness.	Total reports of Thunderstorms for Year 1912.
......	......	......	162	......	......	162^{2}	......	......	162^{3}
......	......	......	163	......	......	......	163	......	163^{2}
......	......	......	......	168^{3}	......	168	168^{3}	......	168^{7}
......	......	......	169	169^{5}	......	169	169^{6}	169	169^{14}
......	......	......	......	......	......	......	170^{2}	170	170^{3}
......	......	172^{2}	......	......	......	172	......	......	172^{3}
173	......	173^{6}	173^{6}	173^{2}	......	173^{5}	173	173^{3}	173^{24}
174	......	......	......	......	......	174	......	......	174^{2}
......	......	......	......	......	......	......	175	175	175^{2}
176	......	......	176^{2}	......	......	......	......	......	176^{3}
......	......	......	177	......	......	177	177	......	177^{3}
......	......	178	......	178	......	......	178	......	178^{3}
......	......	......	179	179	......	......	......	......	179^{2}
182	......	......	......	......	......	......	......	......	182
......	......	......	......	......	......	187^{2}	......	......	187^{2}
......	......	......	......	......	......	190	......	......	190
......	......	......	......	......	......	191	......	......	191
......	......	......	......	......	......	192	......	......	192
......	......	......	......	......	......	193	......	......	193
......	......	......	......	......	......	......	......	200	200
......	......	......	......	......	......	204	......	......	204
......	......	......	......	......	......	205	......	......	205
......	......	......	......	206	......	......	......	......	206
......	209	......	......	......	......	......	......	......	209
......	......	......	......	......	......	217	......	......	217
......	......	......	......	......	......	219	......	......	219
......	......	......	......	......	......	220	......	......	220
......	......	......	......	......	223	......	......	......	223
......	......	......	......	......	......	226	......	......	226
......	......	......	......	......	......	228	......	......	228
......	......	......	......	......	......	230	......	......	230
......	......	......	......	......	......	236	......	......	236
......	......	......	......	......	......	240^{2}	......	......	240^{2}
......	245^{4}	245	......	......	......	......	......	......	245^{5}
......	246	......	246	......	246	246^{3}	......	......	246^{6}
......	......	......	......	......	......	252	......	......	252
......	......	......	......	......	......	254	254	......	254^{2}
......	255	255^{3}	......	......	......	......	255^{3}	......	255^{7}
......	......	256^{2}	256^{2}	......	256^{2}	256^{4}	256^{2}	......	256^{12}
......	......	......	......	......	......	257	......	......	257

THUNDERSTORMS—PHENOLOGICAL OBSERVAEIONS, N.S., 1912.—*Continued.*

The indices indicate the number of stations from which the Thunderstorms were reported on the day of the year specified.

OBSERVATION REGIONS.

1. Yarmouth and Digby.	2. Shelburne, Queens and Lunenburg.	3. Annapolis and Kings.	4. Hants and South Colchester.	5. Halifax and Guysboro.	6. S. Cobequid Slope (S. Cum. and Col.)	7. North Cum., Col., Pictou and Antig.	8. Richmond and Cape Breton.	9 & 10. Victoria and Inverness.	Total reports of Thunderstorms for Year 1912.
......	......	......	......	......	......	258	......	......	258
......	......	......	......	......	......	......	261	......	261
......	......	......	......	262	......	......	262	......	262^{2}
......	......	......	......	......	......	......	263	......	263
......	......	......	......	......	......	264	264^{2}	......	264^{3}
......	265	......	......	......	......	......	......	......	265
......	267	......	......	......	......	......	......	......	267
......	268^{2}	......	......	......	......	......	......	......	268^{2}
......	269^{3}	......	......	......	......	......	......	......	269^{3}
......	......	......	......	......	......	272	......	......	272
......	274^{2}	......	......	......	......	......	274	......	274^{3}
......	......	......	......	......	......	279	......	......	279
......	......	......	......	......	......	281	......	......	281
......	......	......	......	......	......	282	......	......	282
......	......	......	......	......	289	......	......	......	289
......	......	......	......	......	290	......	......	......	290

Stewart Wallace
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